Fibre Channel Test Adapter

User Manual

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Introduction

This user's guide documents the Fibre Channel Plug and Receptacle Test Adapters (FC16-TPA-HCB-P and FC16-TPA-MCB-R), and the Low Speed HCB and MCB Switch Module assemblies. The two test adapter types, shown in Figures 1 and 2, test Fibre Channel interface cables, hosts, and modules to the requirements of the FC-PI-5, FC-MSQS, and SFF-8081 specification. The Calibration Module, shown on Page 13, is used to zero-out test adapter attributes (using SOLT, with either the 1X-THRU or the 2X-THRU).

The TPA-HCB-P and TPA-MCB-R test adapter assemblies allow easy access, via SMA connections, to measure or inject data signals.

NOTE: To avoid damaging the cables, use the handling techniques described in the Care and Handling section before making any connections or configuring a test setup.

Always use a static-safe workstation when performing tests, as explained in the "Electrostatic Discharge Information" section.

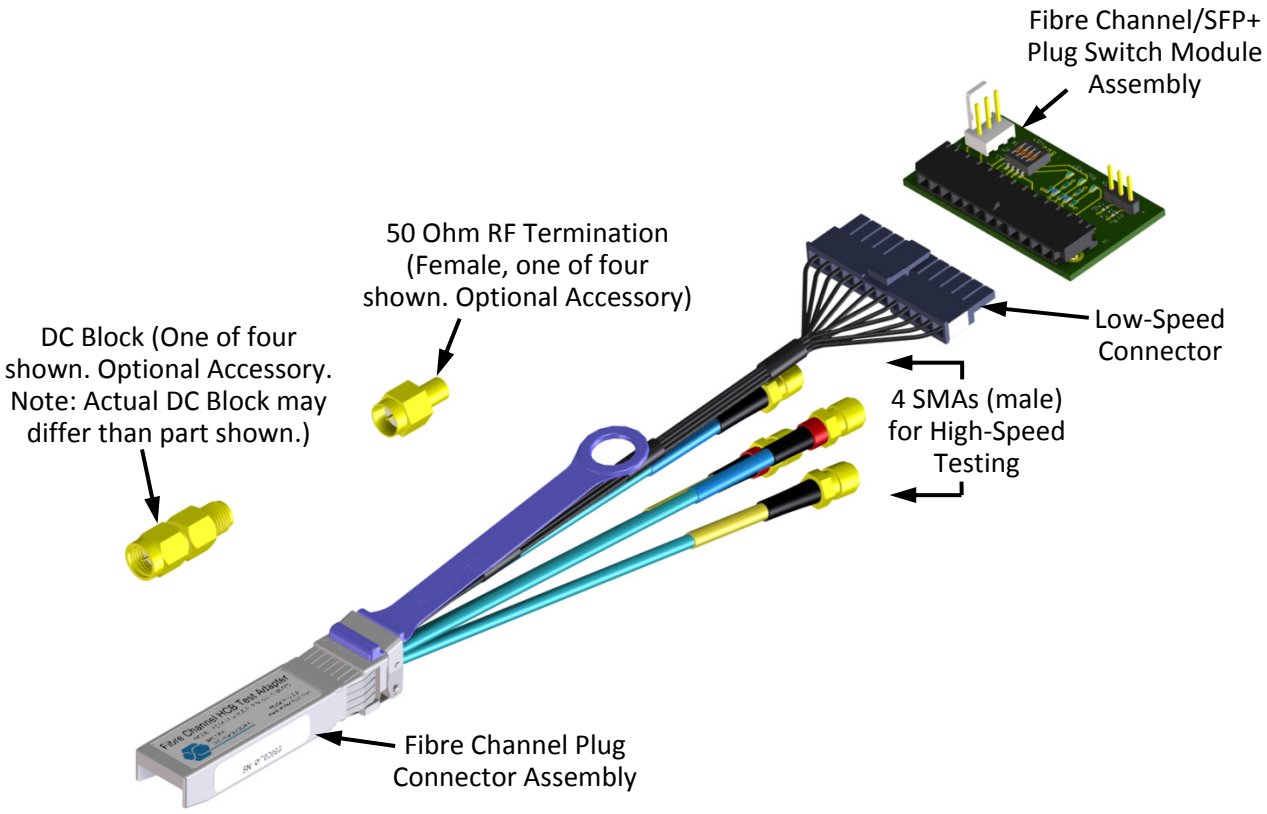

Figure 1. The FC16 HCB Test Adapter tests to the requirements of the Host Compliance Board (Plug)

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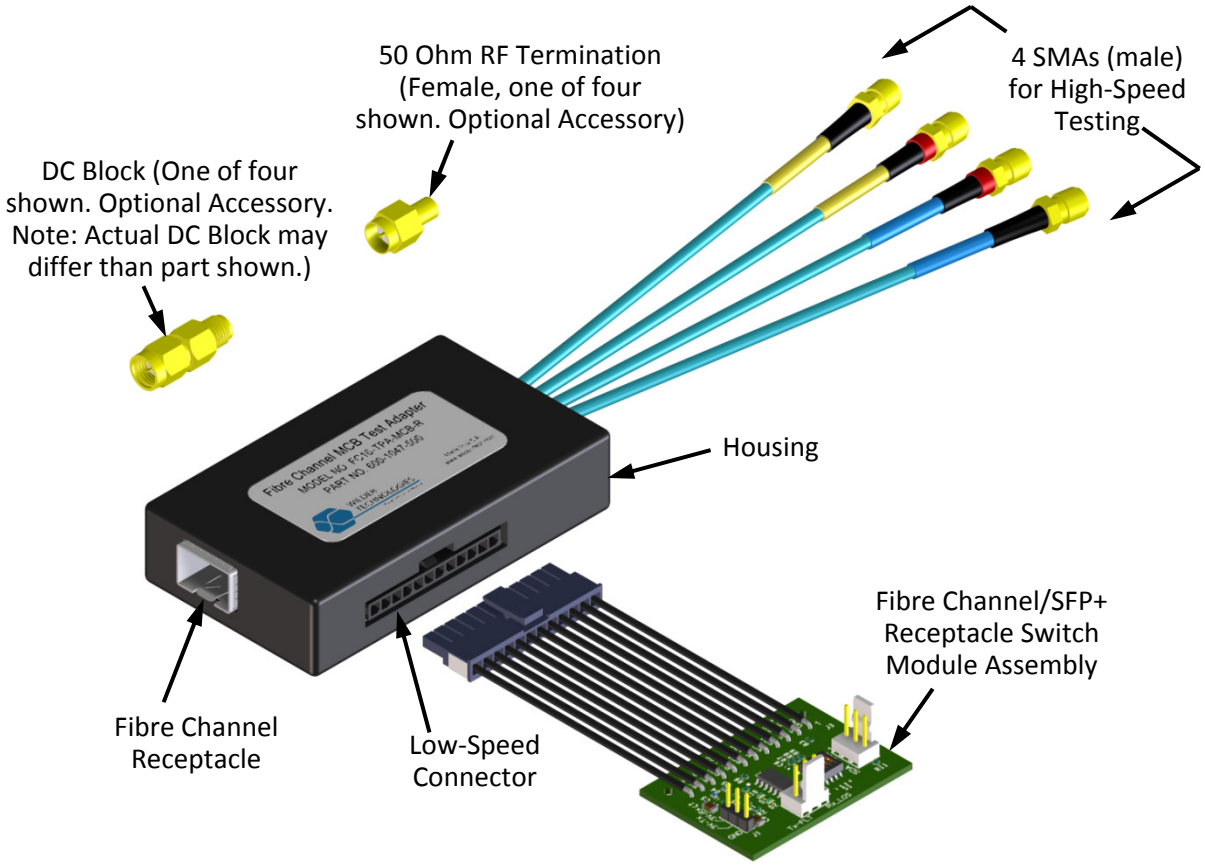

Figure 2. The FC16 MCB Test Adapter tests to the requirements of the Module Compliance Board (Receptacle)

NOTE: The metal shell of both the plug (FC16-TPA-HCB-P) and receptacle (FC16-TPA-MCB-R) connectors tie high-speed ground to chassis ground.

The low-speed 12-position plug connector is keyed and latching (Molex part number 43650-1204). The mating receptacle connector housing and contact pins for 26-30awg wire are Molex part numbers 43640-1200 for the 12-position housing and 43030-0011 for the 26-30awg receptacle contact. Note that the 12-position housing and receptacle contacts are NOT included with the FC16-TPA-MCB-R. These parts can be purchased through Molex distributors.

NOTE: The receiver SMA connections for FC16 are normally AC coupled. The FC16 plug and receptacle TPAs do NOT have internal DC Blocks. This allows for parametric testing through the TPAs. Normal testing may require DC Blocks (May be optionally ordered from Wilder Technologies). Refer to the Electrical Specifications section of this document for DC Block performance parameters.

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Product Inspection

Upon receiving the Fibre Channel TPA from Wilder Technologies, perform the following product inspection:

- Inspect the outer shipping container, foam-lined instrument case, and product for damage. Retain the outer cardboard shipping container until the contents of the shipment have been inspected for completeness and the product has been checked mechanically and electrically. Use the foam-lined instrument-case for secure storage of the Wilder Technologies Fibre Channel Test Adapter when not in use.

- Locate the shipping list and verify that all items ordered were received.

- In the unlikely event that the product is defective or incomplete, the “Limited Warranty” section discusses how to contact Wilder Technologies for technical assistance and/or how to package the product for return.

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The Fibre Channel Test Adapter Care and Handling Precautions

The Fibre Channel Test Adapter requires careful handling to avoid damage. Improper handling techniques, or using too small a cable bend radius, can damage the coaxial cable connections within the adapter housing or the cables themselves. This can occur at any point along the cable. To achieve optimum performance and to prolong the Fibre Channel TPA's life, observe the following handling precautions:

- **CAUTION 1: Avoid Torque Forces** (Twisting)
  While individual coaxial cables within the test adapter have some rotational freedom, twisting the FC16 TPA as a unit, with one end held stationary, may damage or severely degrade performance. Adherence to Caution 5 (below) helps to avoid twisting.

- **CAUTION 2: Avoid Sharp Cable Bends**
  Never bend coaxial cables into a radius of 26 mm (1-inch) or less. Never bend cables greater than 90°. Single or multiple cable bends must be kept within this limit. Bending the FC16 TPA cables less than a 26mm (1-Inch) radius will permanently damage or severely degrade test adapter performance.

- **CAUTION 3: Avoid Cable Tension** (Pull Forces)
  Never apply tension (pull forces) to an individual coaxial cable that is greater than 2.3 kg (5 lbs.). To avoid applying tension, always place accessories and equipment on a surface that allows adjustment to eliminate tension on the FC16 TPA and cables. Use adjustable elevation stands or apparatus to accurately place and support the FC16 TPA.

- **CAUTION 4: Connect the FC16 TPA First**
  To prevent twisting, bending, or applying tension to the coaxial cables when connecting a FC16 TPA, always attach the FC16 TPA to the device under test (DUT) or cable under test before attaching any SMA connectors. Carefully align the FC16 connectors and then gently push the connectors together until fully seated.

  If the FC16 TPA must be turned or twisted to make connection to the DUT, avoid using the FC16 TPA housing alone to make this occur. Try to distribute the torque forces along the length of the test setup and cabling. If this is not possible, it is recommended to first loosen or disconnect the SMA connections at the FC16 TPA, make the connection to the DUT and then re-tighten or attach the test equipment leads.

  NOTE: Only grip the test adapter housing when inserting or extracting the FC16 TPA to or from the DUT. Pulling directly on the FC16 TPA cables or using them to insert the FC16 TPA may cause damage.

- **CAUTION 5: Carefully Make SMA Connections**
  To connect the Fibre Channel TPA SMA connectors, follow these steps:

  1. Hold the cable stationary by grasping the cable at the black heat-shrink section near the SMA connector.

  2. Insert the mating SMA barrel and hand-tighten the free-spinning SMA nut onto the connector while avoiding pulling, bending, or twisting the FC16 TPA coaxial cable.

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3. The FC16 TPA SMA connectors have flats that accept an open-end 5/16-inch wrench. When attaching instrument cables to the FC16 TPA, it is recommended that the FC16 TPA SMA connectors be mechanically held and the test leads be tightened to the equipment manufacturer's torque recommendations, normally 5 in-lbs, using a 5/16-inch open-end wrench.

If the test set-up requires repositioning, first loosen or disconnect the SMA connections to avoid twisting, bending, or tension.

NOTE: A drop in signal amplitude by half or 6db during the testing of a channel may indicate that a cable has been mechanically pulled free of coaxial cable connections internal to the assembly. This could be determined by checking if the cable has any lateral play relative to the TPA. This would only occur when the TPA has exceeded the pull force as specified within the mechanical specification. If the cable cannot be re-seated, the test adapter will need to be sent back to the factory for service.

- **CAUTION 6: Independently Support Instrument Cables or Accessories**
  Excessive weight from instrument cables and/or accessories connected to the FC16 TPA can cause damage or affect the test adapter performance. Be sure to provide appropriate means to support and stabilize all test set-up components.

- **CAUTION 7: The FC16-TPA-MCB-R Switch Module is ESD Sensitive**
  The FC16-TPA-MCB-R Switch Module assembly incorporates electrostatic sensitive components. Additionally, when an active DUT is installed, that device also becomes susceptible to ESD. Observe proper ESD precautions, further discussed later in this document.

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General Test Adapter, Cable, and Connector

Observing simple precautions can ensure accurate and reliable measurements.

Handling and Storage

Before each use of the FC16 TPA, ensure that all connectors are clean. Handle all cables carefully and store the FC16 TPA in the foam-lined instrument case when not in use, if possible. Do not set connectors contact end down. Install the SMA protective end caps when the FC16 TPA is not in use.

Visual Inspection

Be sure to inspect all cables carefully before making a connection. Inspect all cables for metal particles, scratches, deformed threads, dents, or bent, broken, or misaligned center conductors. Do not use damaged cables.

Cleaning

If necessary, clean the connectors using low-pressure (less than 60 PSI) compressed air or nitrogen with an effective oil-vapor filter and condensation trap. Clean the cable threads, if necessary, using a lint-free swab or cleaning cloth moistened with isopropyl alcohol. Always completely dry a connector before use. Do not use abrasives to clean the connectors. Re-inspect connectors, making sure no particles or residue remains.

Making Connections

Before making any connections, review the “Care and Handling Precautions**”** section. Follow these guidelines when making connections:

- Align cables carefully
- Make preliminary connection lightly
- To tighten, turn connector nut only
- Do not apply bending force to cable
- Do not over-tighten preliminary connections
- Do not twist or screw-in cables
- Use a torque wrench, and do not tighten past the “break” point of the torque wrench

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Electrostatic Discharge Information

Protection against electrostatic discharge (ESD) is essential while connecting, inspecting, or cleaning the FC16 TPA test adapter and connectors attached to a static-sensitive circuit (such as those found in test sets).

Electrostatic discharge can damage or destroy electronic components. Be sure to perform all work on electronic assemblies at a static-safe work station, using two types of ESD protection:

- Conductive table-mat and wrist-strap combination
- Conductive floor-mat and heel-strap combination

When used together, both of these types provide a significant level of ESD protection. Used alone, the table-mat and wrist-strap combination provide adequate ESD protection. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Acceptable ESD accessories may be purchased from a local supplier.

WARNING: These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.

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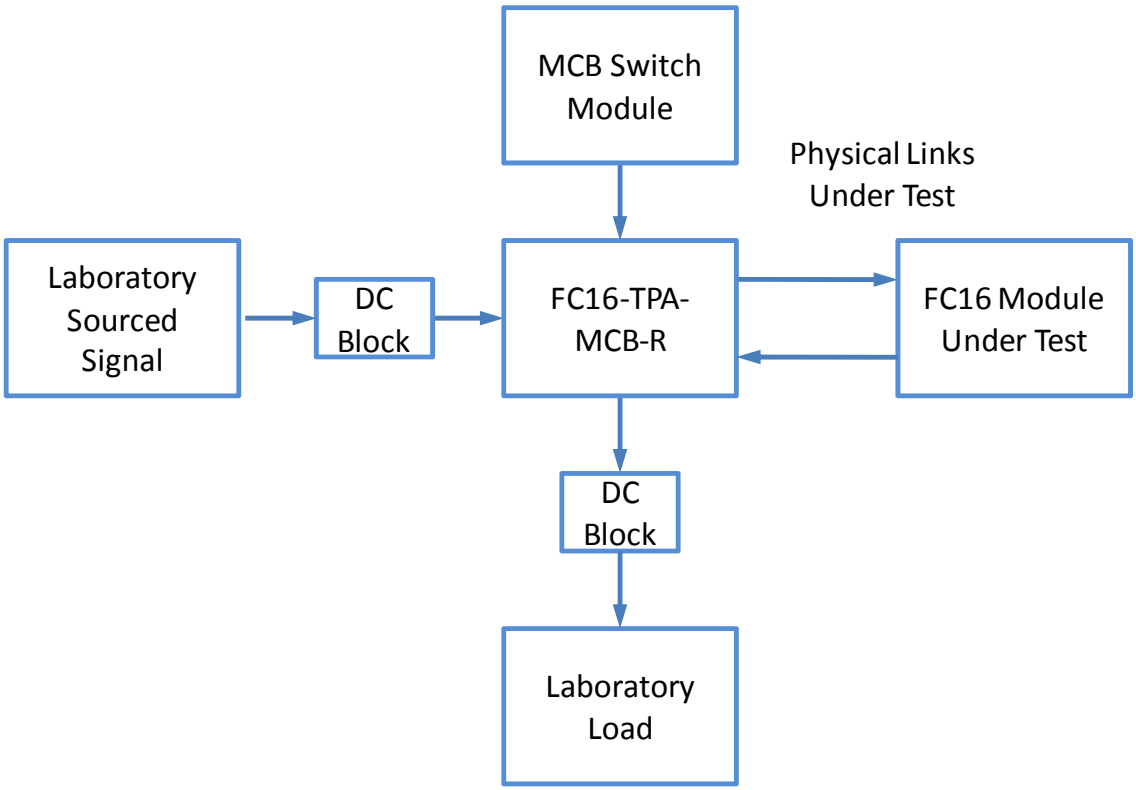
User Model

The Fibre Channel TPAs are capable of performing to the requirements of FC-PI-5 and SFF-8081 specification, limited only by the specifications, environmental, care and handling of this document.

In the case where the laboratory source or load is not used in the test, it must be replaced with RF terminations on each unused signal (RF terminators are optionally offered by Wilder Technologies).

The following examples are suggestions for possible testing setups.

In this first example, a FC16-TPA-MCB-R and associated Switch Module assembly is used to test a Fibre Channel Module:



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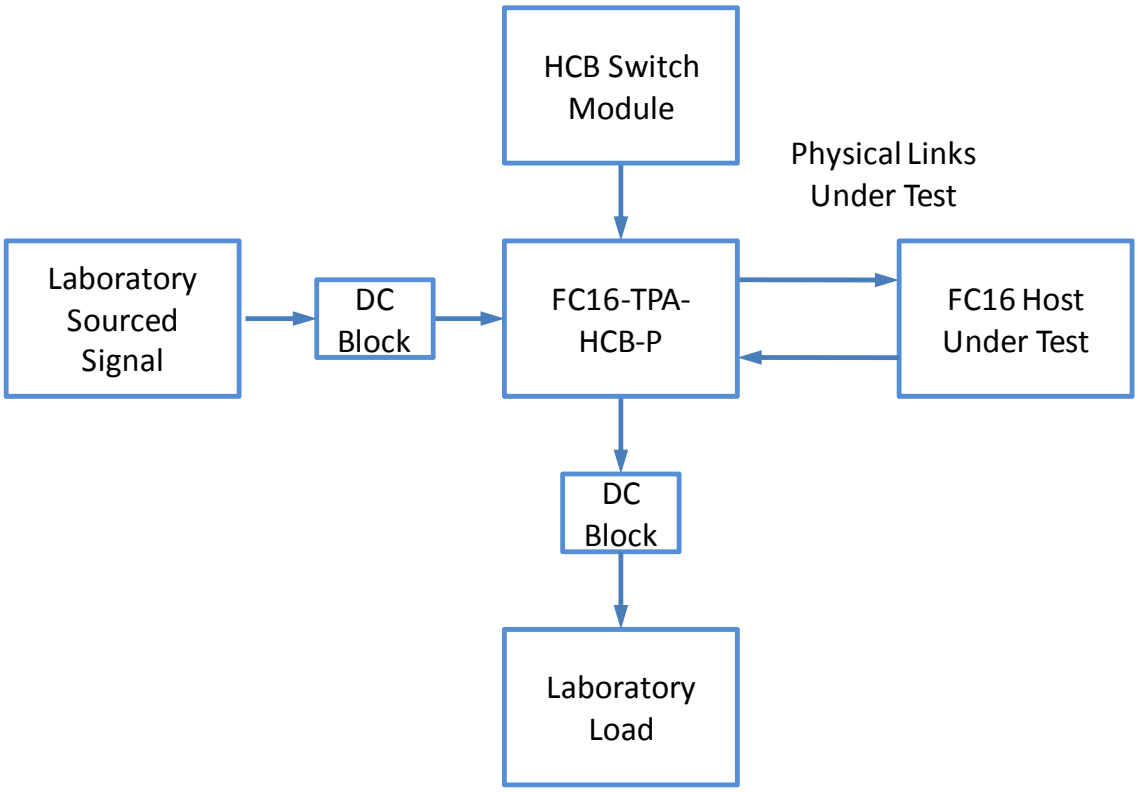
The second example shows a FC16-TPA-HCB-P and associated Switch Module assembly is used to test a host:

In the case where the laboratory source or load is not used in the test, it must be replaced with RF terminations on each unused signal (RF terminators are optionally offered by Wilder Technologies).



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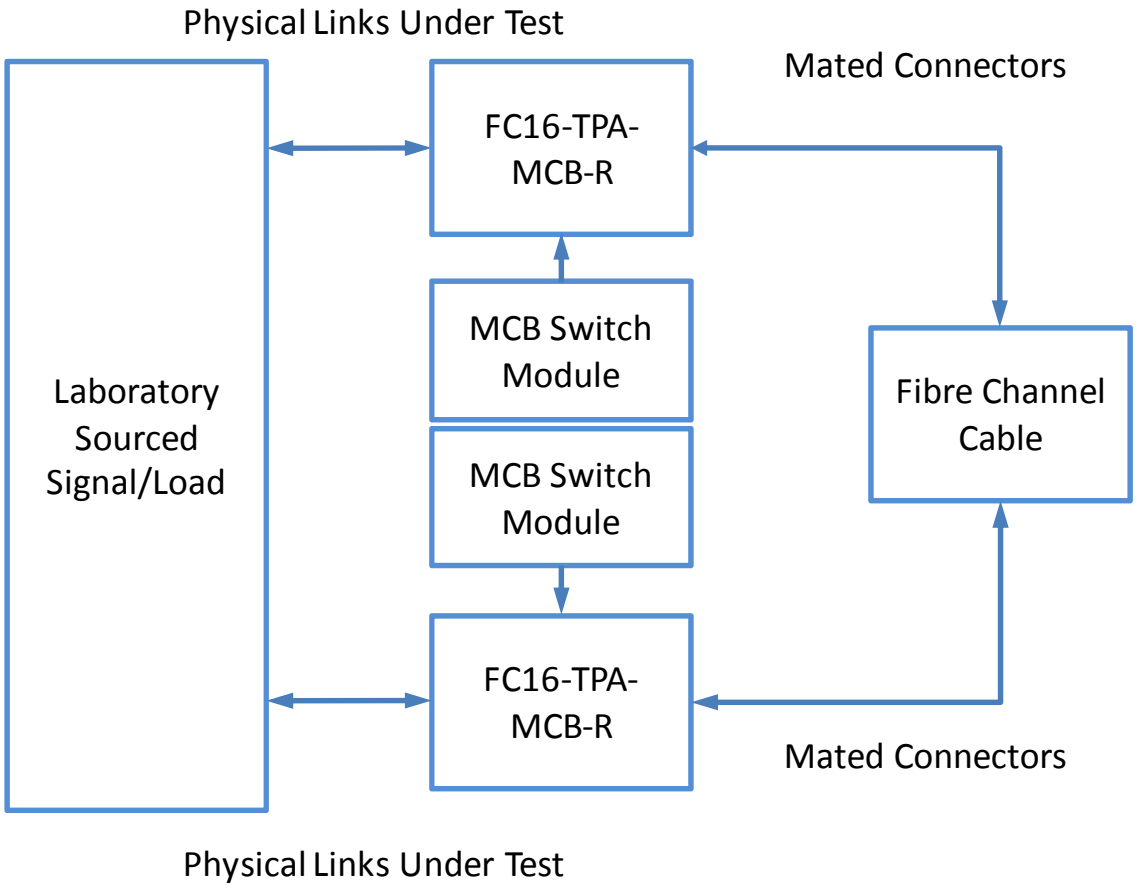
The third example shows two FC16-TPA-MCB TPAs-R's used for testing a Fibre Channel cable:



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Calibration

The Fibre Channel HCB and MCB Test Adapters are passive components. Therefore, calibration for the errors generated must occur within the test instrumentation that drives the Fibre channel receiver device or looks at the response of the Fibre Channel transmitter device.

The FC16-TPA-C calibration Module is used to provide 2X-THRU, 1X-THRU, SHORT, OPEN, and LOAD functionality.

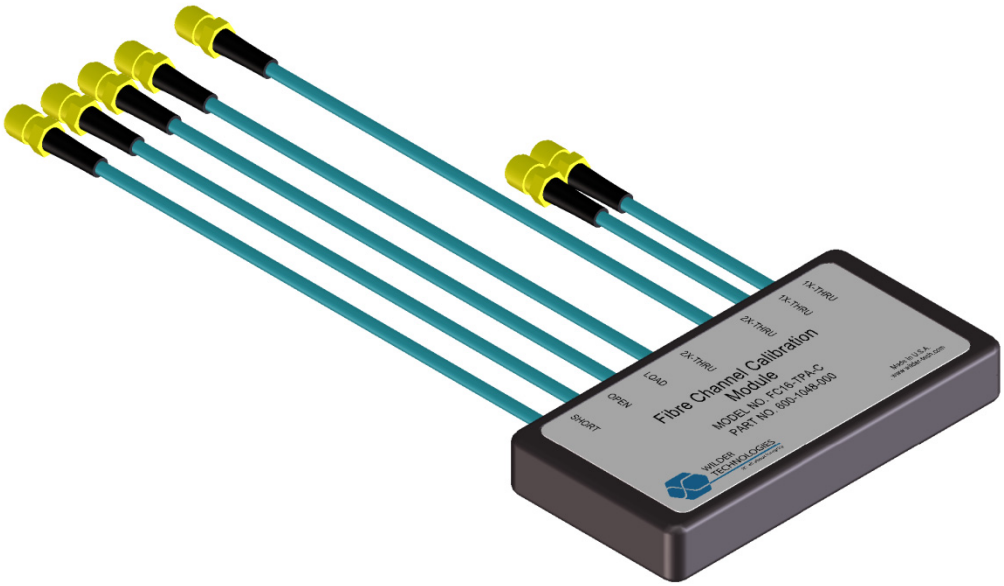

Figure 3. Calibration Module (FC16-TPA-C) showing standard 6-inch cable on SOLT and 3-inch cables connected to the 1X-THRU

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SOLT

SHORT, OPEN, LOAD, and 2X-THRU (SOLT) are calibration standards used to compensate for errors associated with the TPA when used for Jitter measurement, TDR, TDT, and VNA testing. SOLT represents the same electrical length and losses as the TPA through the Fibre Channel connector pad, and enables the test engineer to compensate for the following six repeatable, systematic errors that occur when moving the reference plane:

- Signal leakage effects: *Directivity errors*
- Signal leakage effects: *Crosstalk errors*
- Reflection effects: *Source Impedance Mismatching errors*
- Reflection effects: *Load Impedance Mismatching errors*
- Bandwidth effects: *Receiver Transmission in Test Equipment errors*
- Bandwidth effects: *Receiver Reflection-tracking in Test Equipment errors*

These errors need to be corrected on each port. Refer to the Instrument Manual for instructions on the instrument's specific calibration process.

NOTE: The reference plane is the boundary, both physically and electrically, between the calibrated and uncalibrated portions of the circuit. Everything outside the reference plane is considered part of the DUT. Any instrument that does not use calibration defines the DUT as the total of externally connected components. If the FC16-TPA-C is not used, all of the FC16-TPA and the 6-inch cables, as well as cables connecting the 6-inch cables to the test instrument, would be a part of the DUT.

Non-repeatable errors, such as drift or random errors, can be reduced but not corrected. Drift errors aggregate over time or with environmental changes such as temperature shift. To eliminate drift errors, perform another calibration.

A random error cannot be corrected through calibration since the error occurred randomly. Random errors are typically associated with either test instrument noise or test repeatability problems. Reduce test instrument noise by increasing source power, lowering the IF bandwidth, or averaging results over multiple sweeps. Reduce test repeatability problems through the use of a torque wrench or, again, by averaging over multiple sweeps.

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1X-THRU

The 1X-THRU is a calibration feature used to calibrate time domain instrumentation (for example, pre-emphasized pulse generators or AWGs, arbitrary waveform generators). 1X-THRU calibration compensates two error sources – cable losses and group delay:

- **Cable Losses** – Cable losses associated with the Fibre Channel receptacle TPA, and its respective cabling that's connected to the test source, consist of skin loss and, to a lesser extent, dielectric loss. Pre-emphasis or de-emphasis is used at the signal source to correct for these cable losses. Pre-emphasis is a boost of the signal level just after an edge transition; de-emphasis is a reduction in the low-speed amplitude of the signal source. Typically, on a de-emphasized signal the levels have to be reset to attain the same output levels. Resultant signals from either pre-emphasis or de-emphasis are identical relative to the DUT.

  For the purposes of this discussion, pre-emphasis will be used. To set the pre-emphasis, first determine the amount of signal boost by connecting the signal source, via the 1X-THRU and the respective cable used to connect the DUT to the source to a high-speed oscilloscope or a jitter measurement device. Trigger the oscilloscope or jitter measurement device using a trigger from the source. The trigger, a single event, indicates the start of the signal being sent to the DUT. Adjust pre-emphasis to maximize the eye opening.

- **Group Delay** – Group delay is the second error source for 1X-THRU calibration. When the DUT generates an output signal, it can be used to measure delay. To create a baseline delay measurement, connect the output signal cable to the input signal cable and the 1X-THRU. To determine corrected DUT delay, subtract this baseline measurement from the DUT delay measurements.

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Mechanical and Environmental Specifications

NOTE: All specifications in this manual are subject to change.

Table 1. General Specifications

ITEM	DESCRIPTION
Usage Environment	Controlled indoor environment
Plug Test Adapter Length (w/standard cables)	205.6 mm +/- 2 mm (8.09 inches +/- .08 inches) (Characteristic)
Receptacle Test Adapter Length (w/std. cables)	218.11 mm +/- 2 mm (8.59 inches +/- .08 inches) (Characteristic)
Operating Temperature	0°C to +55°C (32°F to +131°F) (Characteristic)
Storage Temperature	-40°C to +70°C (-40°F to +158°F) (Characteristic)

FC16-TPA-HCB-P and FC16-TPA-MCB-R Cable Pinout

The Fibre Channel TPA cables provide four SMA connectors (one lane of primary differential TX and RX). Labels clearly mark each cable or connector. The following figure refers to the pin-description table for the plug connector.

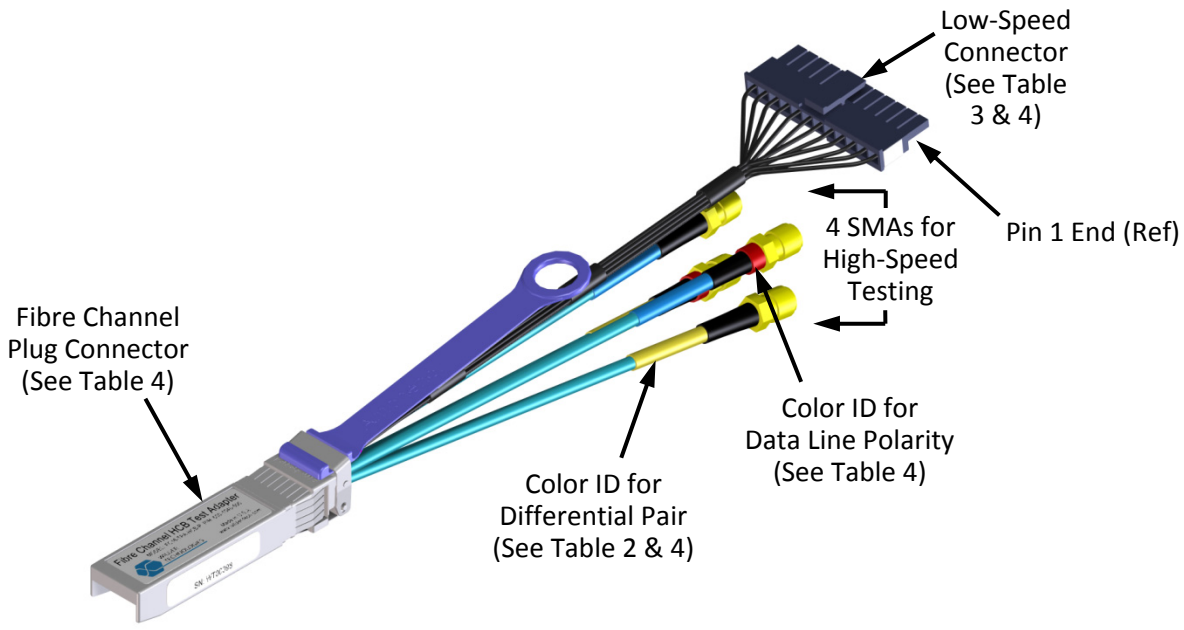
Low-Speed Connector (See Table 3 & 4)
Pin 1 End (Ref)
4 SMAs for High-Speed Testing
Fibre Channel Plug Connector (See Table 4)
Color ID for Data Line Polarity (See Table 4)
Color ID for Differential Pair (See Table 2 & 4)

Figure 4. Cable Connectors (FC16-TPA-HCB-P shown)

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The following figure refers to the FC16-TPA-HCB-P Switch Module assembly. Refer to the FC-MSQS specification for test details and settings of the Switch Module assembly. (Note: The default settings for switch S1 are Pin-1-Off, Pin-2-Off, Pin-3-Off, Pin-4-NC.)

The mating 3-position receptacle connector housings and contact receptacles for 22-30awg wire are provided with each FC16-TPA-HCB-P Switch Module assembly, allowing the user to create custom Switch Module cables. (Molex part number 22-01-2035 for the housings and 08-55-0102 for the receptacle contacts). Replacement plug parts can be purchased through Molex distributors.

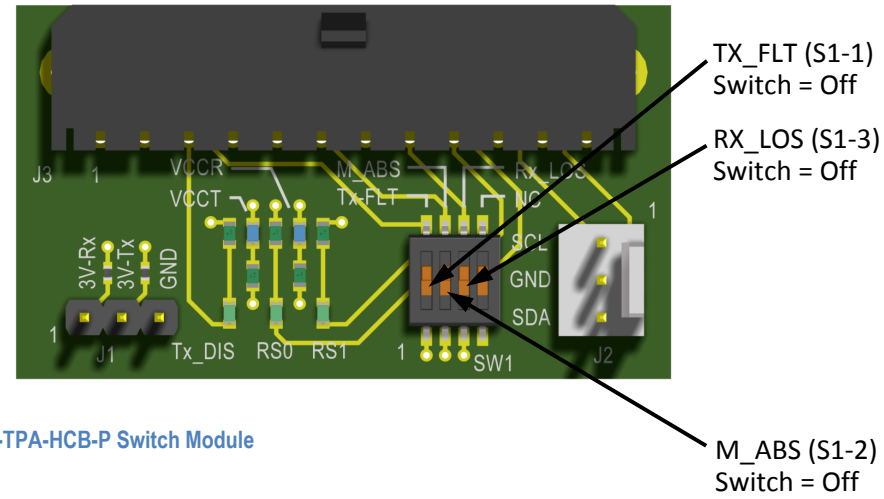

Figure 5. FC16-TPA-HCB-P Switch Module

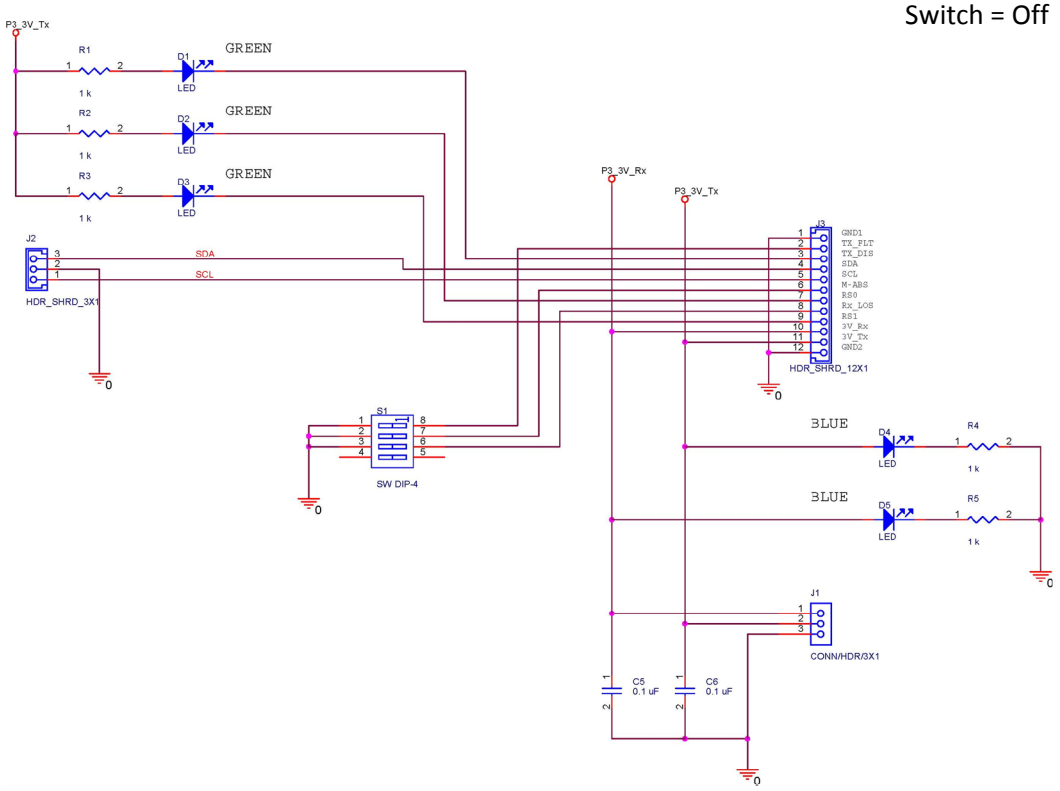

Figure 6. FC16-TPA-HCB-P Switch Module Schematic

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The following figure refers to the pin-description table for the receptacle connector.

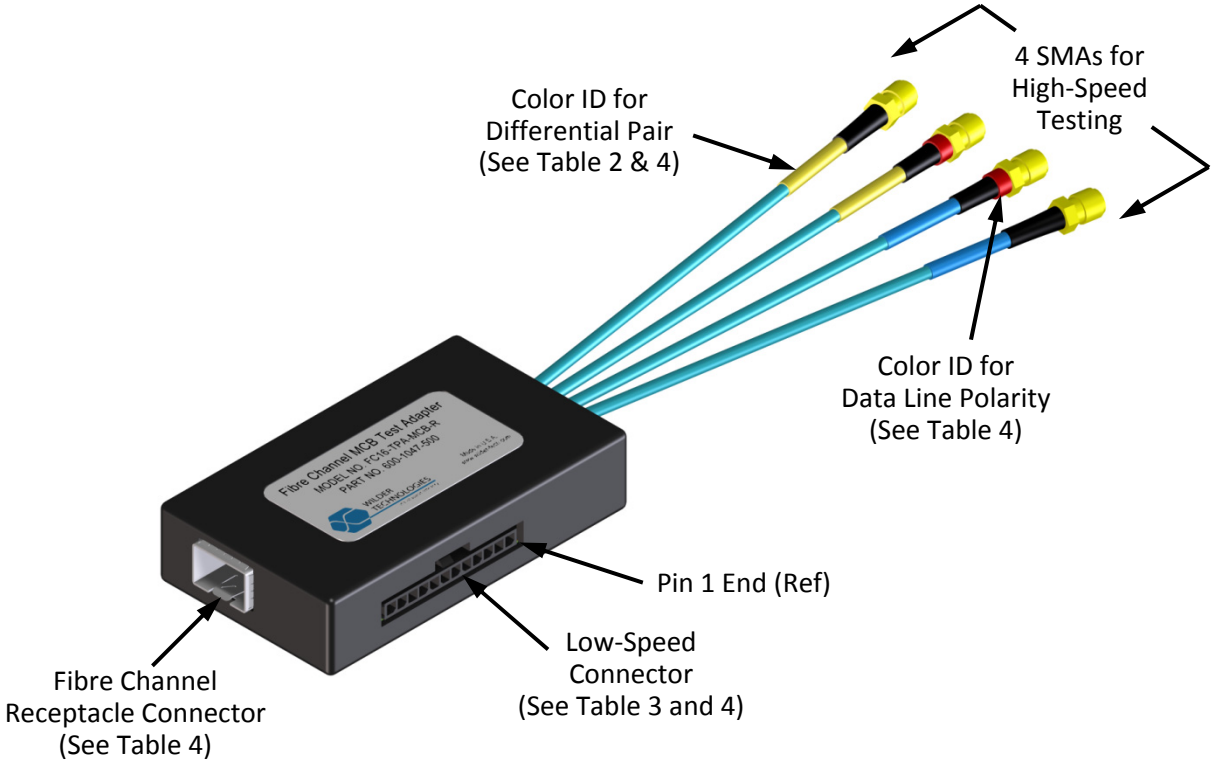

Figure 7. Cable Connectors (FC16-TPA-MCB-R shown)

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The following figure refers to the FC16-TPA-MCB-R Switch Module assembly. Refer to the FC-MSQS specification for test details and settings of the Switch Module assembly. (Note: The default settings for switch S1 are Pin-1-On, Pin-2-Off, Pin-3-Off, Pin-4-NC.)

The mating 3-position receptacle connector housings and contact receptacles for 22-30awg wire are provided with each FC16-TPA-MCB-R Switch Module assembly, allowing the user to create custom Switch Module cables. (Molex part number 22-01-2035 for the housings and 08-55-0102 for the receptacle contacts). Replacement plug parts can be purchased through Molex distributors.

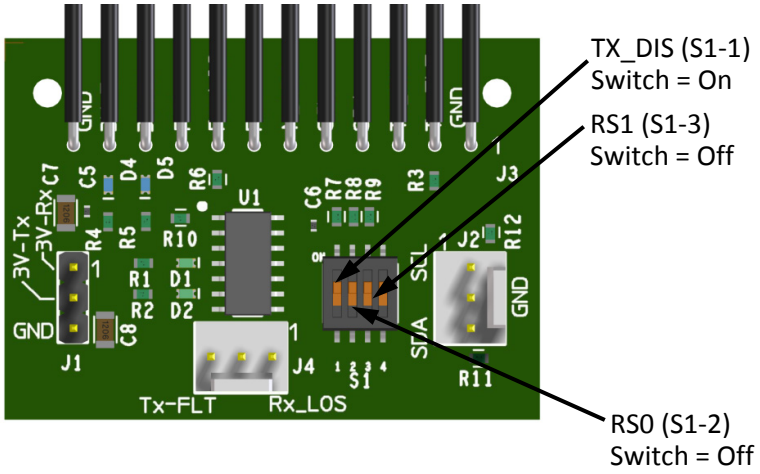

Figure 8. FC16-TPA-MCB-P Switch Module

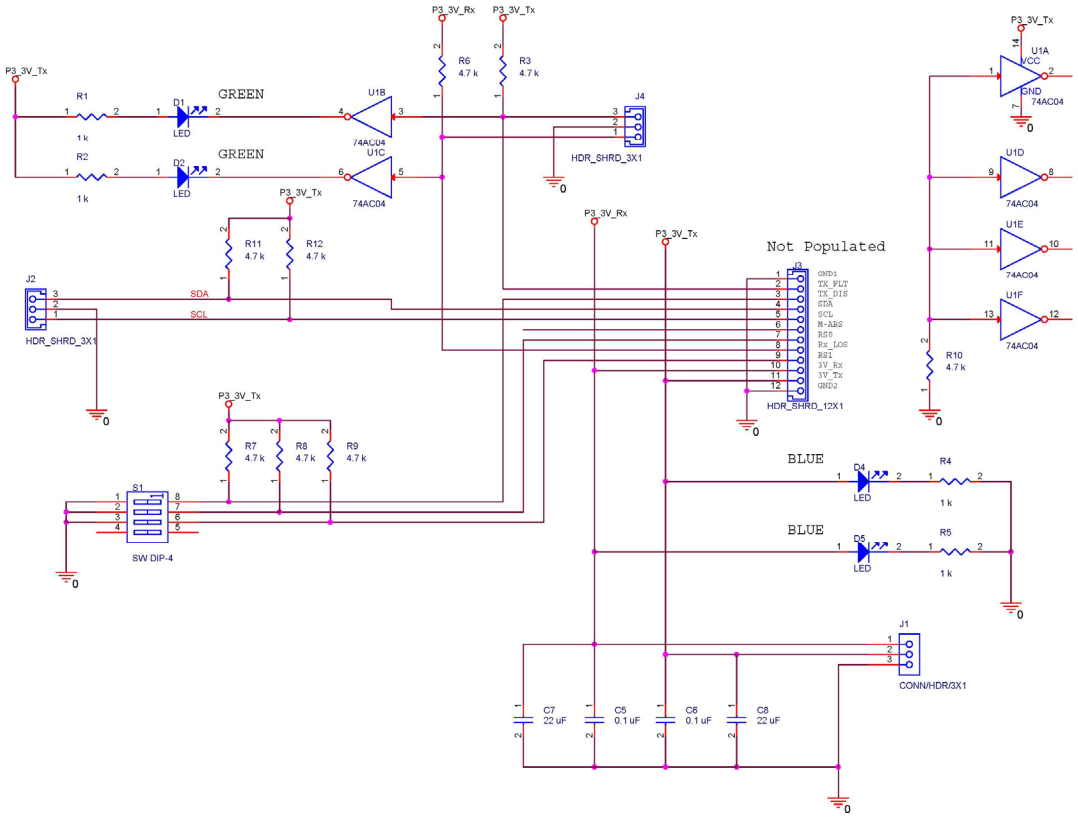

Figure 9. FC16-TPA-MCB-R Switch Module Schematic

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Table 2. SMA Cable Connectors (High-Speed)

LABEL	COLOR ID FOR DIFFERENTIAL PAIR	DESCRIPTION
RD+	Blue	Receive positive for Host, Transmit positive for Module
RD-	Blue	Receive negative for Host, Transmit negative for Module
TD+	Yellow	Transmit positive for Host, Receive positive for Module
TD-	Yellow	Transmit negative for Host, Receive negative for the Module

Table 3. FC16-TPA 12-Position Cable Connector (Low-Speed)

LABEL	PIN NO.	COLOR ID FOR HCB/MCB	DESCRIPTION
GND	Pin 1	Black/NA	VeeR and VeeT, RF Ground
TXF	Pin 2	Black/NA	Tx_Fault, Transmit fault
TXD	Pin 3	Black/NA	Tx_Disable, Transmit disable
SDA	Pin 4	Black/NA	SDA, I^2C Data for DDC
SCL	Pin 5	Black/NA	SCL, I^2C Clock for DDC
ABS	Pin 6	Black/NA	MOD_ABS, Module absent
RS0	Pin 7	Black/NA	RS0, Rate select 0
LOS	Pin 8	Black/NA	Rx_LOS, Loss of Receive Signal
RS1	Pin 9	Black/NA	RS1, Rate select 1
VCR	Pin 10	Black/NA	VccR, module receiver power supply
VCT	Pin 11	Black/NA	Vcct, module transmitter power supply
GND	Pin 12	Black/NA	VeeR and VeeT, RF Ground

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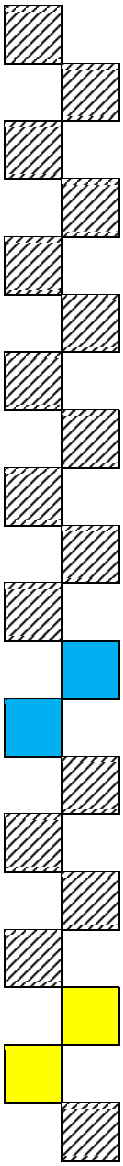
Table 4. FC16 Plug and Receptacle Pin Assignments

Pin Description	Connector Pin Number	Destination Number (HCB/MCB)	Color ID for Data Line Polarity	Color Identification (HCB/MCB)
RF Ground	1	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA
Tx Fault	2	P2/J2 Pin 2	N/A	Black Insulation/NA
Tx Disable	3	P2/J2 Pin 3	N/A	Black Insulation/NA
SDA	4	P2/J2 Pin 4	N/A	Black Insulation/NA
SCL	5	P2/J2 Pin 5	N/A	Black Insulation/NA
Mod_ABS	6	P2/J2 Pin 6	N/A	Black Insulation/NA
RS0	7	P2/J2 Pin 7	N/A	Black Insulation/NA
Rx_LOS	8	P2/J2 Pin 8	N/A	Black Insulation/NA
RS1	9	P2/J2 Pin 9	N/A	Black Insulation/NA
RF Ground	10	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA
RF Ground	11	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA
RD-	12	RD-	Black	Blue Label
RD+	13	RD+	Red	Blue Label
RF Ground	14	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA
VccR	15	P2/J2 Pin 10	N/A	Black Insulation/NA
VccT	16	P2/J2 Pin 11	N/A	Black Insulation/NA
RF Ground	17	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA
TD+	18	TD+	Red	Yellow Label
TD-	19	TD-	Black	Yellow Label
RF Ground	20	P2/J2 Pin 1, Pin 12	N/A	Black Insulation/NA



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Electrical Specifications

NOTE: All specifications in this manual are subject to change.

Table 5. Electrical Specifications (TPA)

SPECIFICATION	MIN	TYP	MAX	NOTES
Insertion Loss (db), at -3 dB	18	22.2		2X-THRU of FC16-TPA-C Cal Module
Return Loss (GHz), at -20 dB	12	14.7		2X-THRU of FC16-TPA-C Cal Module
Insertion Loss (db), at -3 dB	25	>26.5		1X-THRU of FC16-TPA-C Cal Module
Return Loss (GHz), at -20 dB	5	7.2		1X-THRU of FC16-TPA-C Cal Module
VSWR, at 5 GHz (calculated)	1.22:1			2X-THRU of FC16-TPA-C Cal Module
Differential Impedance (ohms), 34 ps Rise Time, 20 – 80%	92		108	All Differential Pairs, Receptacle and Plug, excluding FC16 connector
Differential Impedance (ohms), 34 ps Rise Time, 20 – 80%	90		115	All Differential Pairs, Receptacle and Plug, including FC16 connector.
Impedance (ohms), 34 ps Rise Time, 20 – 80%	46		54	All Differential Pairs, Receptacle and Plug, excluding FC16 connector
Impedance (ohms), 34 ps Rise Time, 20 – 80%	47.5		52.5	1X-THRU and 2X-THRU (FC16-TPA-C)
Intra-pair Skew (ps)	-6		6	All Differential Pairs, Receptacle and Plug
Inter-pair Skew (ps)	-6		6	All Differential Pairs, Receptacle and Plug
NEXT (GHz), at -40 dB		22.7		Single aggressor, mated Fibre Channel TPAs, with standard coaxial cables and terminations
FEXT (GHz), at -40 dB		13.8		Single aggressor, mated Fibre Channel TPAs, with standard coaxial cables and terminations

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Table 6. Electrical Specifications (Optional External DC Block) as Supplied by Wilder Technologies

SPECIFICATION	MIN	TYP	MAX	NOTES
Insertion Loss (db), at 100 kHz - 12.4 GHz at 12.4 - 26.5 GHz		 0.50 0.75		
VSWR, 7kHz TO 26.5 GHz			1.35	
Upper -3db Bandwidth (GHz)	26.5			
Lower -3db Bandwidth (kHz)			7	
Voltage		100 Volts Max.		
In-Line Capacitance (µF)		0.474		
Impedance (Ohms)		50		

Table 7. Electrical Specifications (Optional RF Termination) as Supplied by Wilder Technologies

SPECIFICATION	MIN	TYP	MAX	NOTES
VSWR, DC to 4 GHz 4 to 12.4 GHz 12.4 to 18 GHz			 1.05 1.15 1.20	
Frequency Range (GHz)	DC		18	
Power Dissipation (Watts)			2	Power derates linearly from 100% ≤ 25°C to 10% @ 125°C
Impedance (Ohms)		50		

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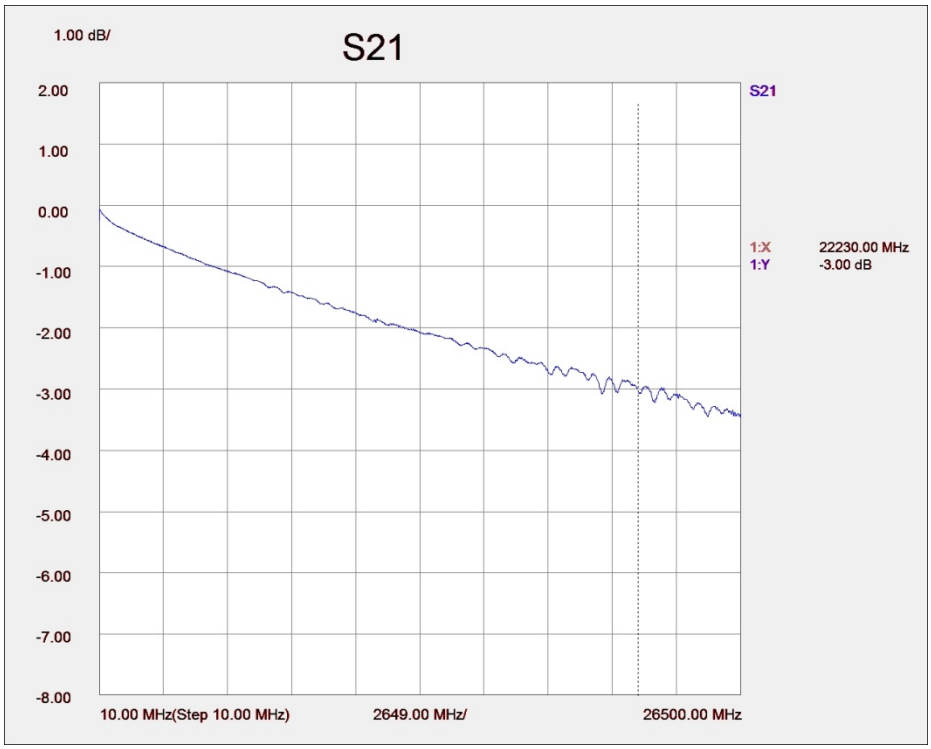

Figure 10. Typical 2X-THRU insertion loss.

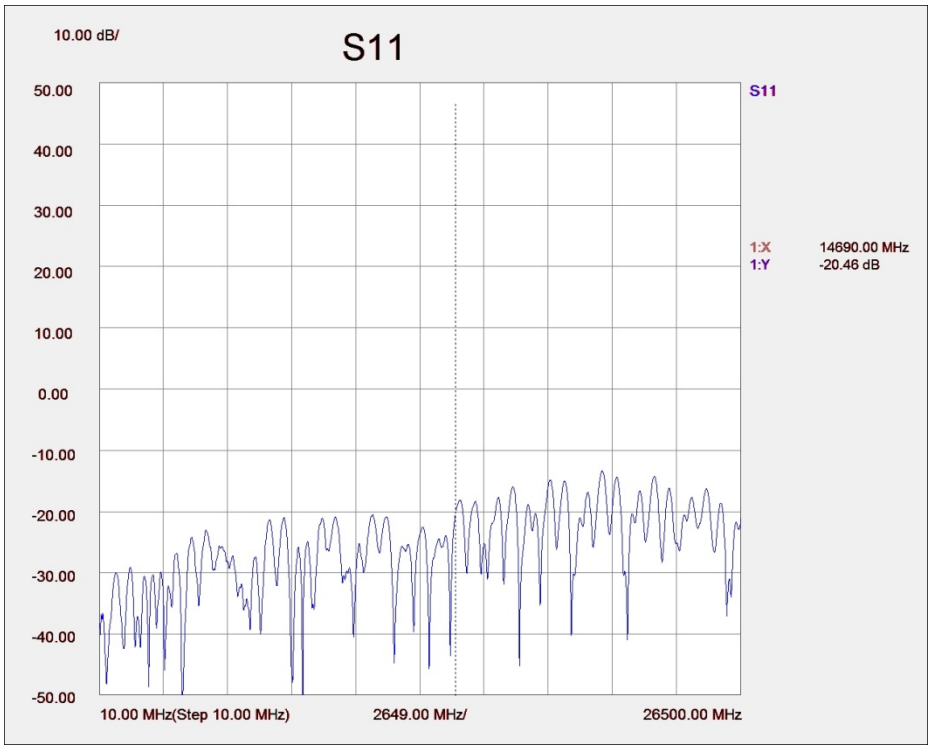

Figure 11. Typical 2X-THRU return loss.

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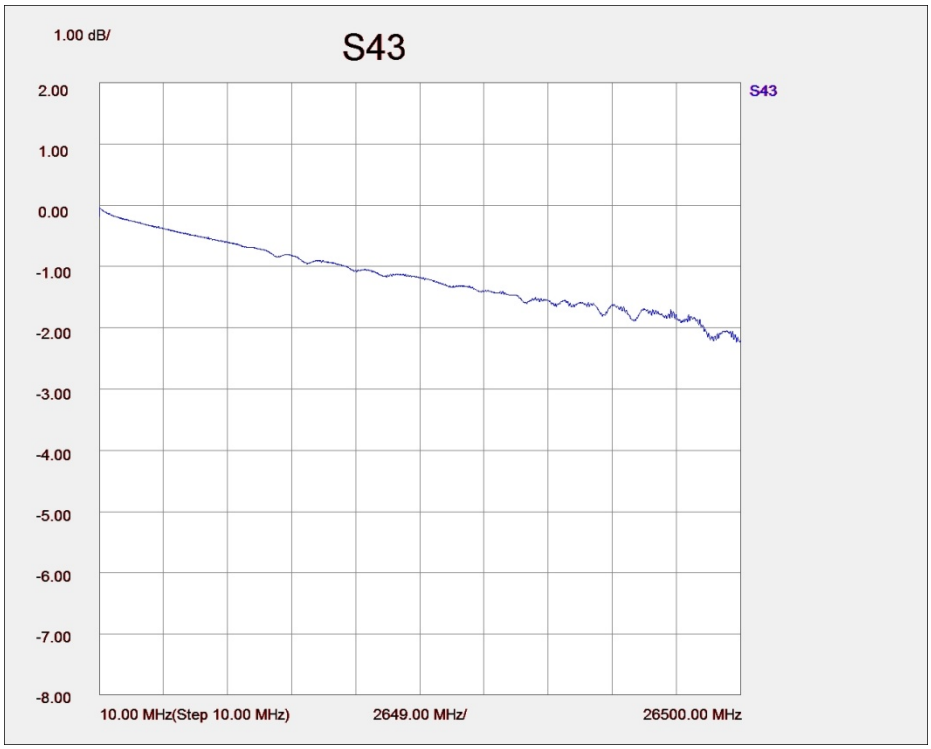

Figure 12. Typical 1X-THRU insertion loss.

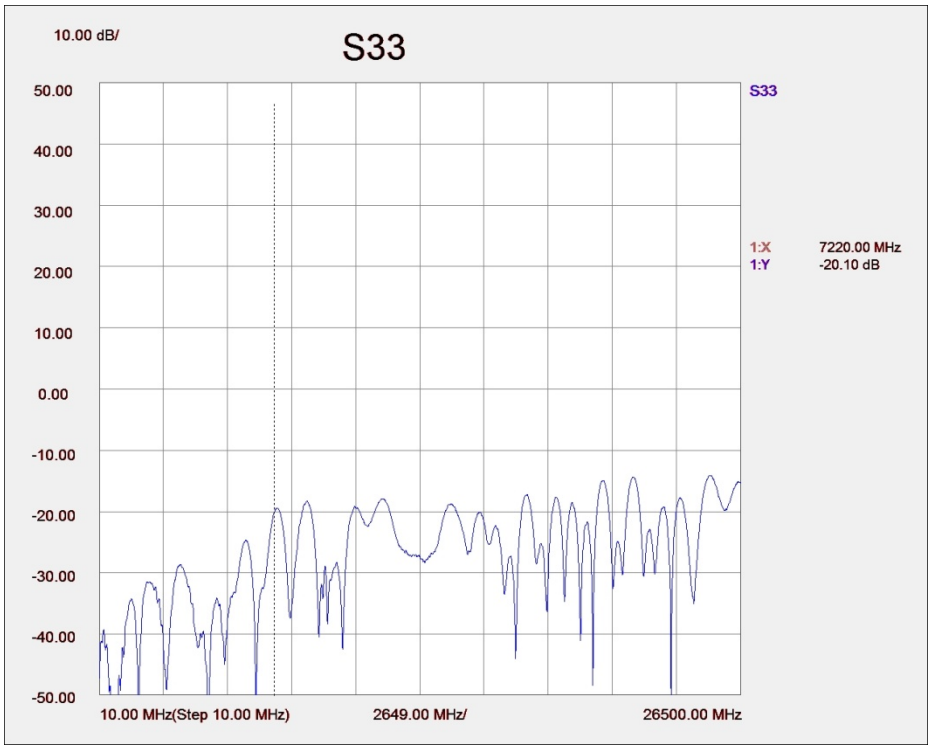

Figure 13. Typical 1X-THRU return loss.

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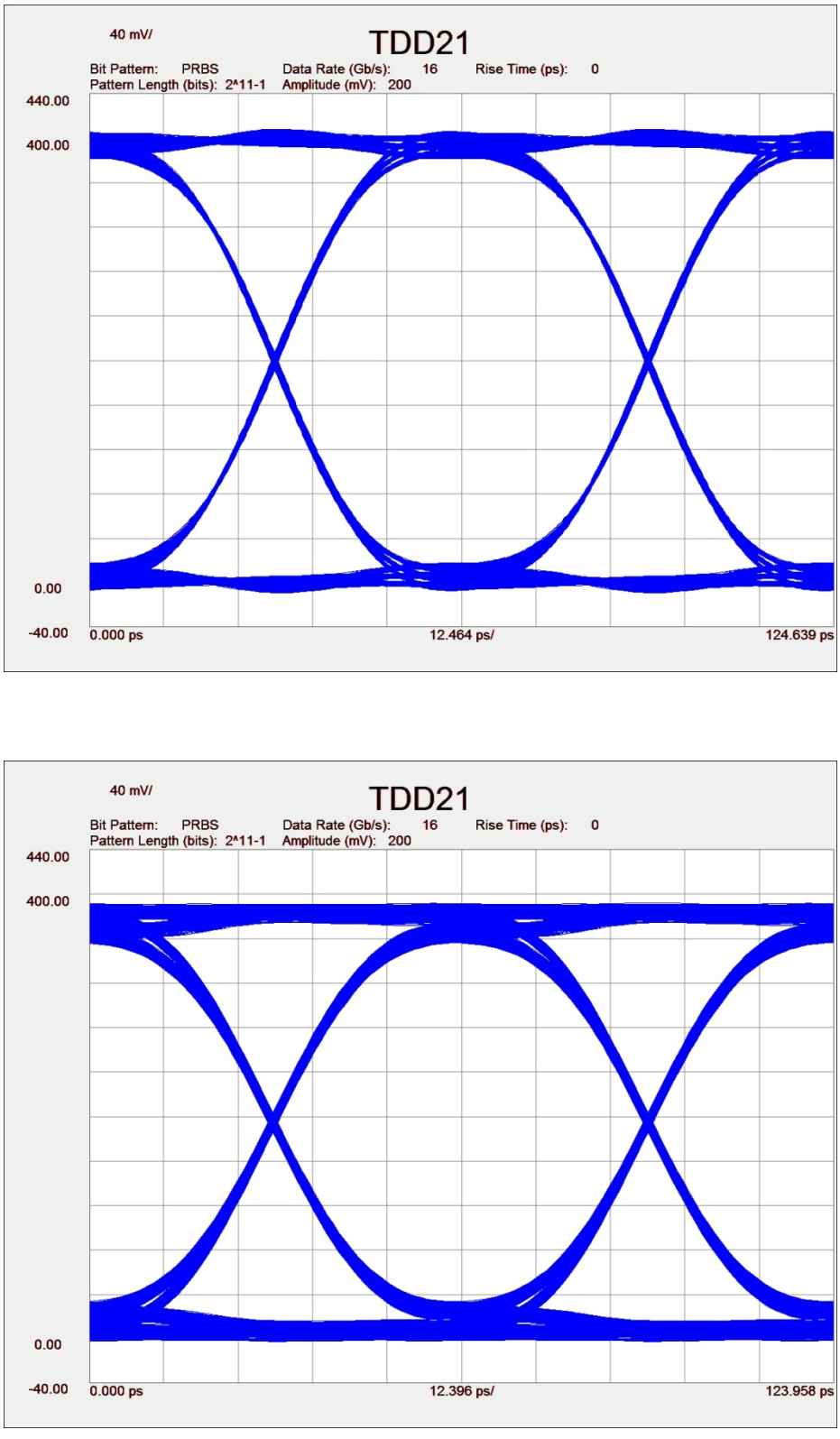

Figure 14. Typical mated pair 16 Gb/s eye diagram, with calibration (top) and without calibration (bottom).

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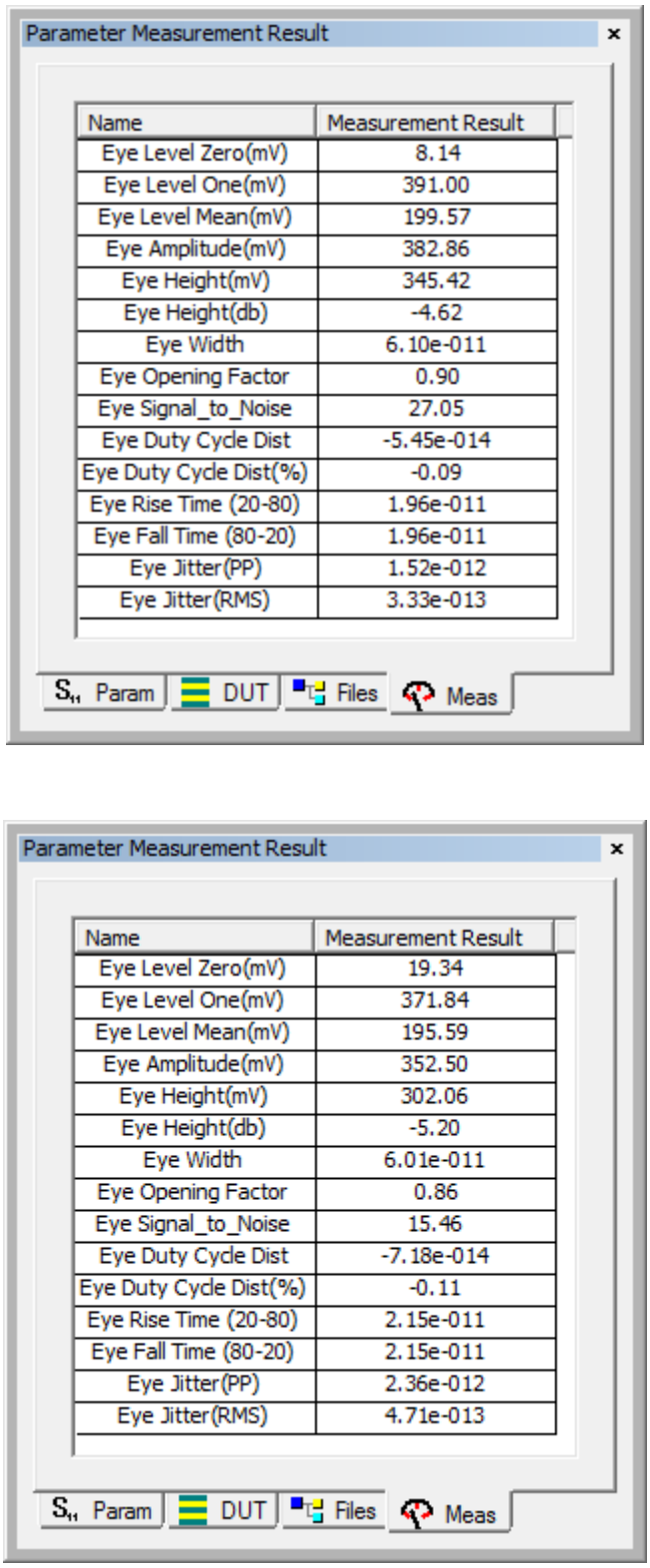

Figure 15. Typical mated pair 25 Gb/s eye data, with calibration (top) and without calibration (bottom).

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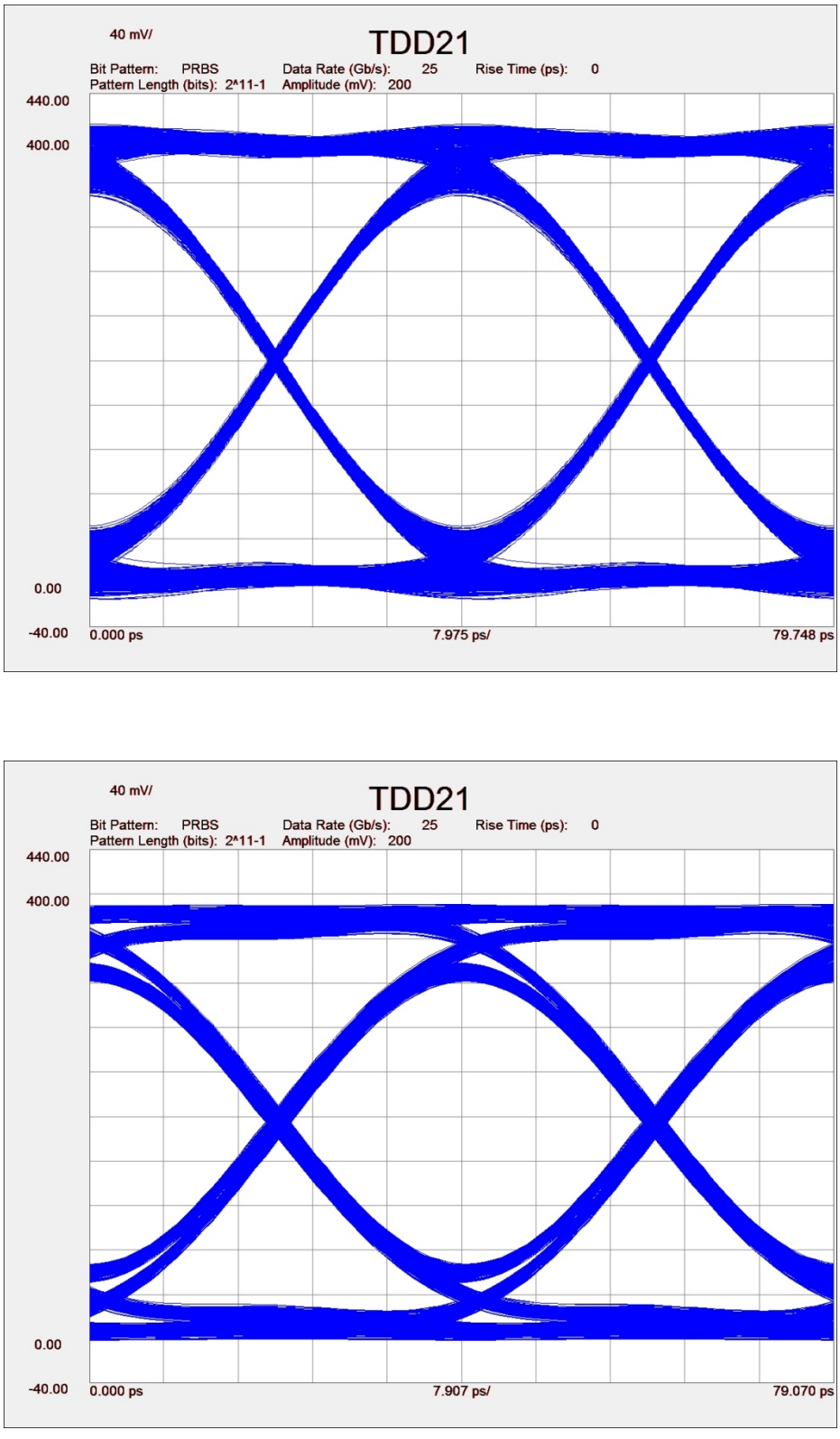

Figure 16. Typical mated pair 25 Gb/s eye diagram, with calibration (top) and without calibration (bottom).

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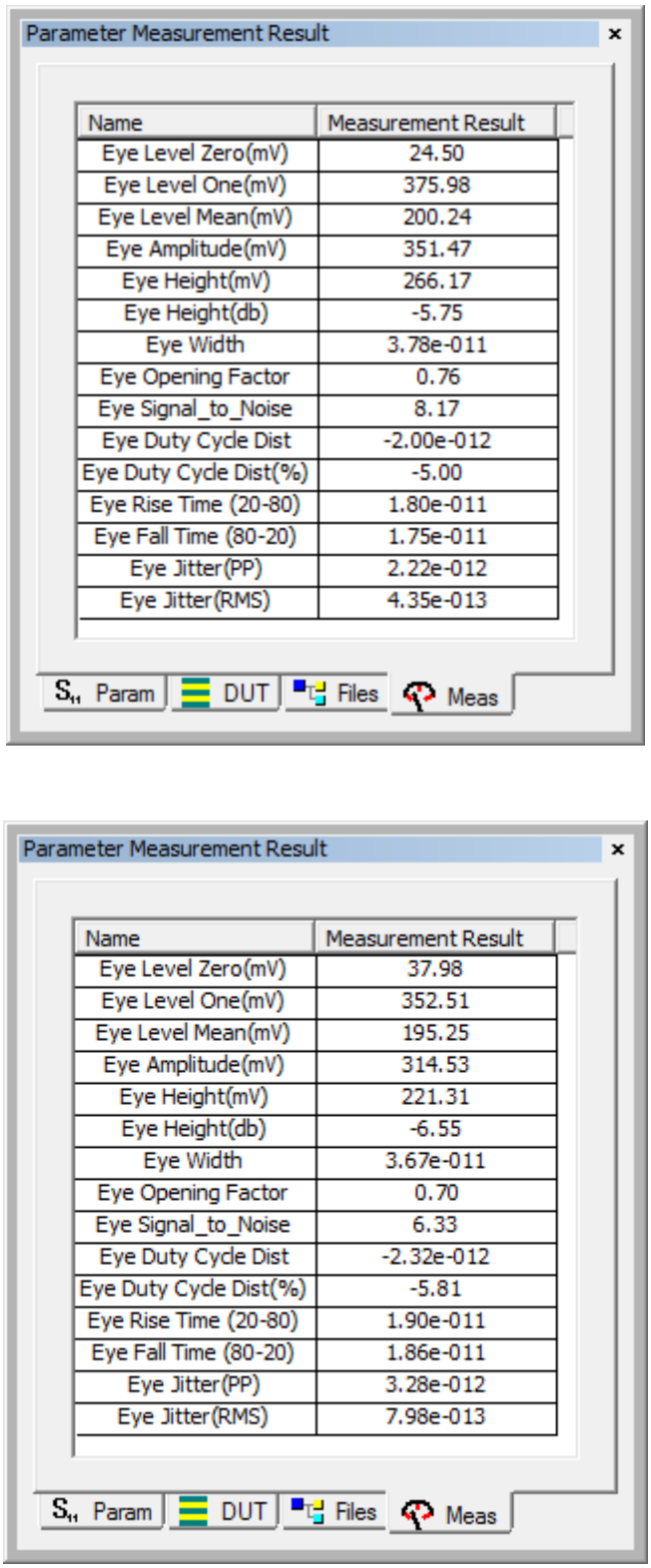

Figure 17. Typical mated pair 25 Gb/s eye data, with calibration (top) and without calibration (bottom).

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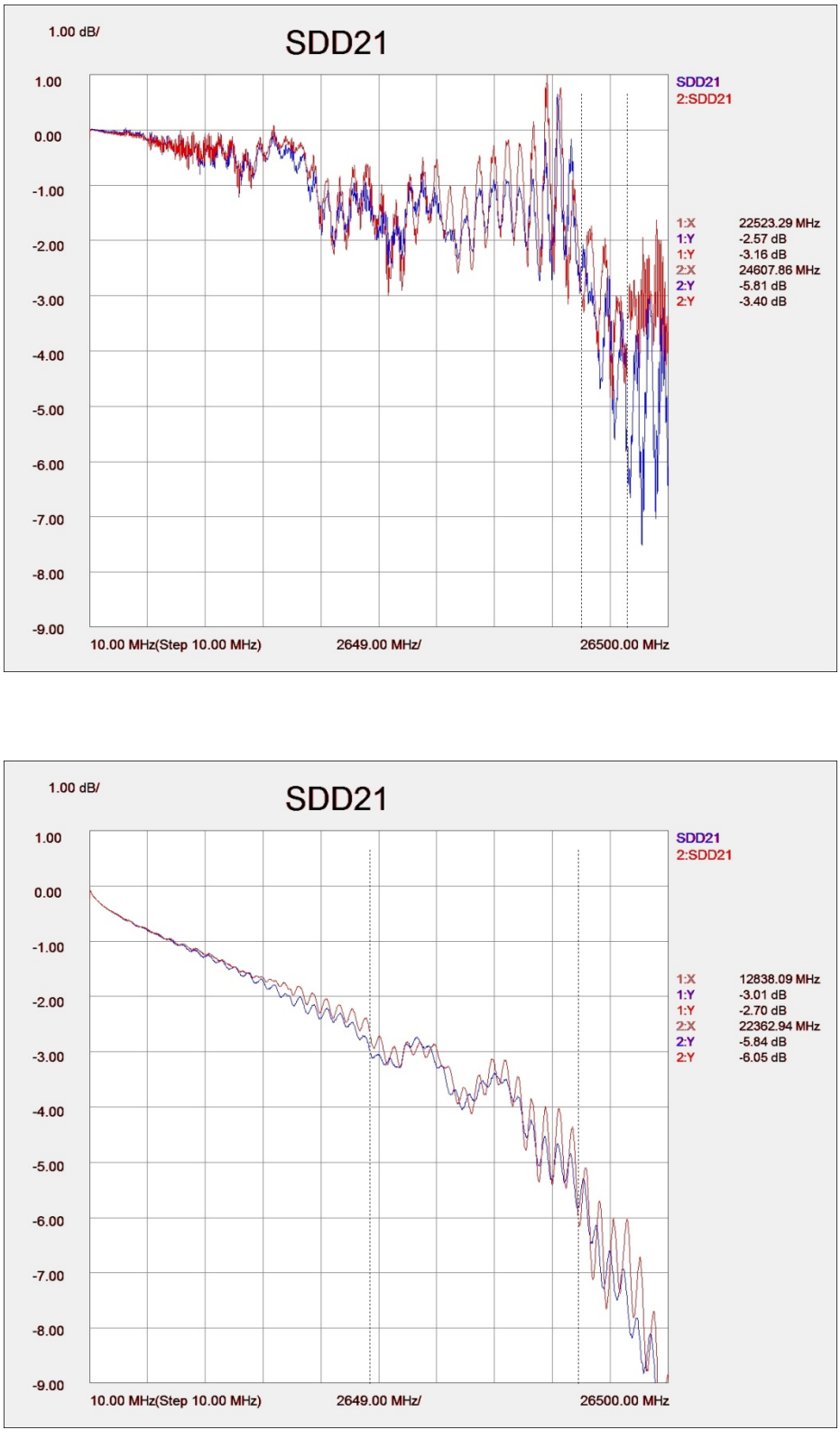

Figure 18. Typical mated pair balanced insertion loss, with calibration (top) and without calibration (bottom).

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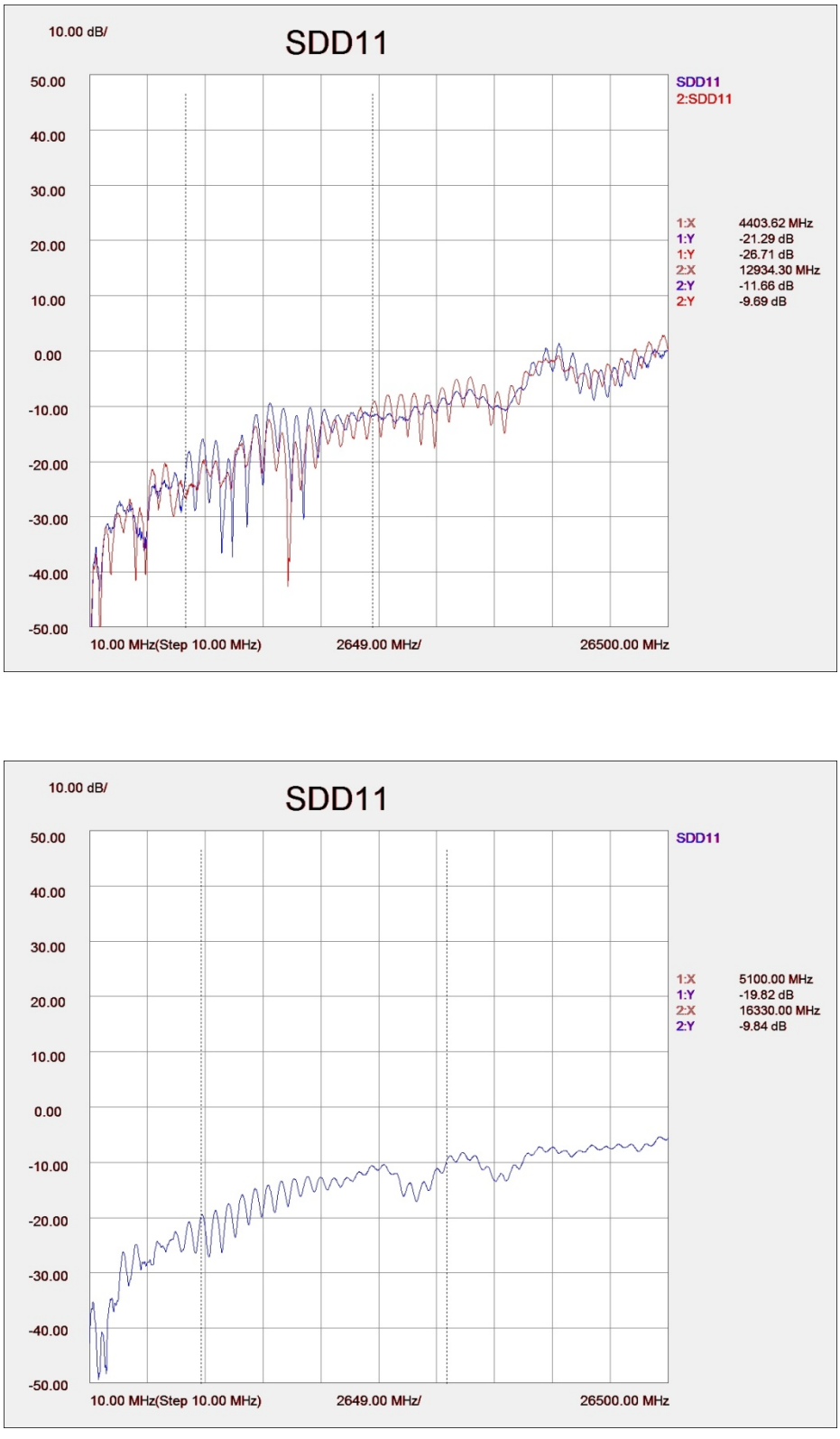

Figure 19. Typical mated pair balanced return loss, with calibration (top) and without calibration (bottom).

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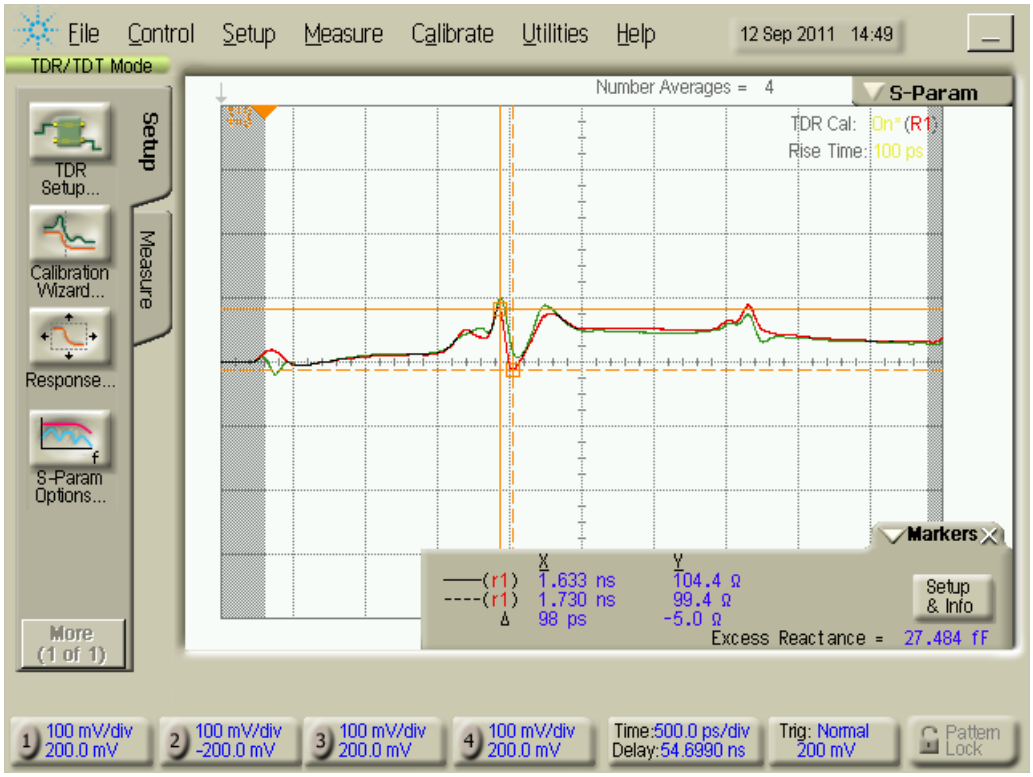

Figure 20. Typical differential TDR of FC16-TPA-HCB-P connected to FC16-TPA-MCB-R at 100ps Rise Time.

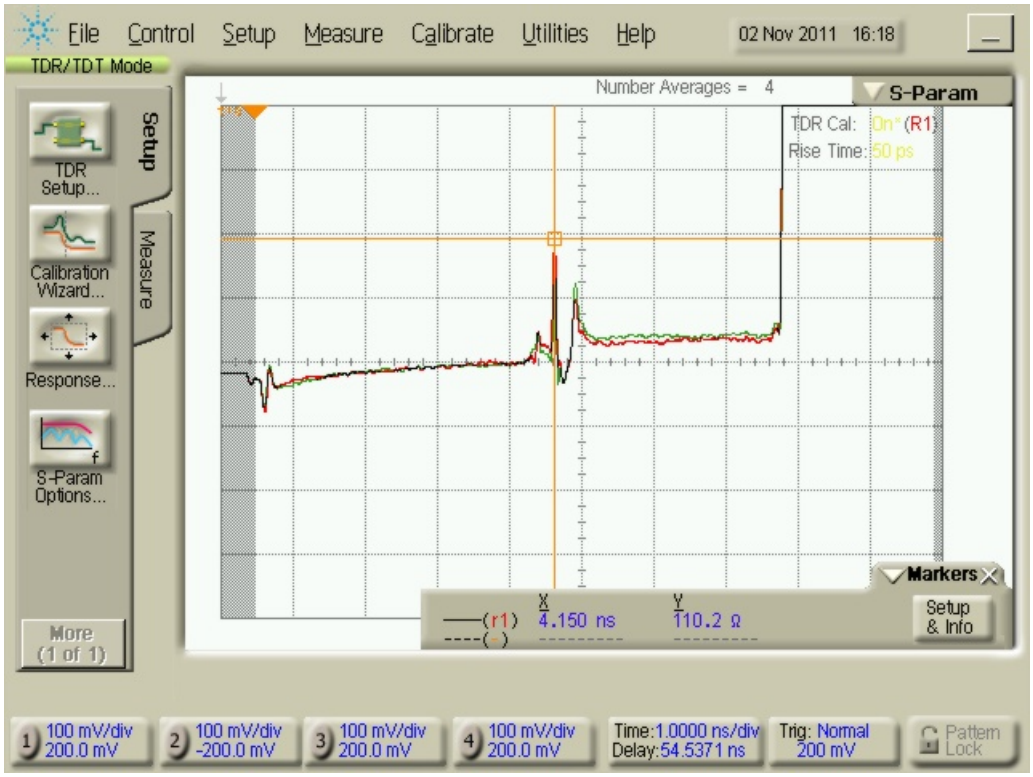

Figure 21. Typical differential TDR of FC16-TPA-HCB-P connected to FC16-TPA-MCB-R at 34ps Rise Time (20-80%) (Measured at 50 ps 10-90%).

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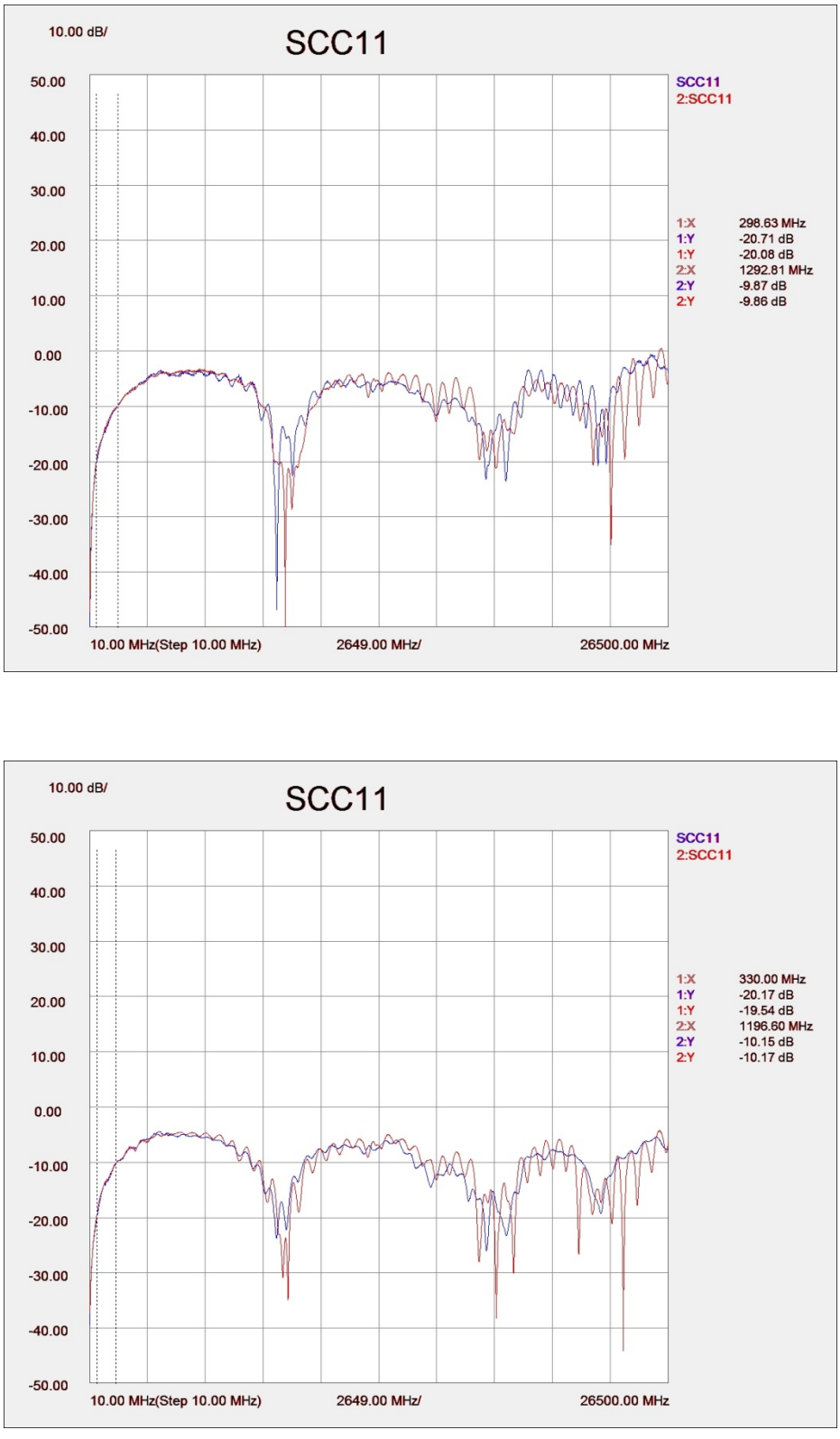

Figure 22. Typical mated pair common mode return loss, with calibration (top) and without calibration (bottom).

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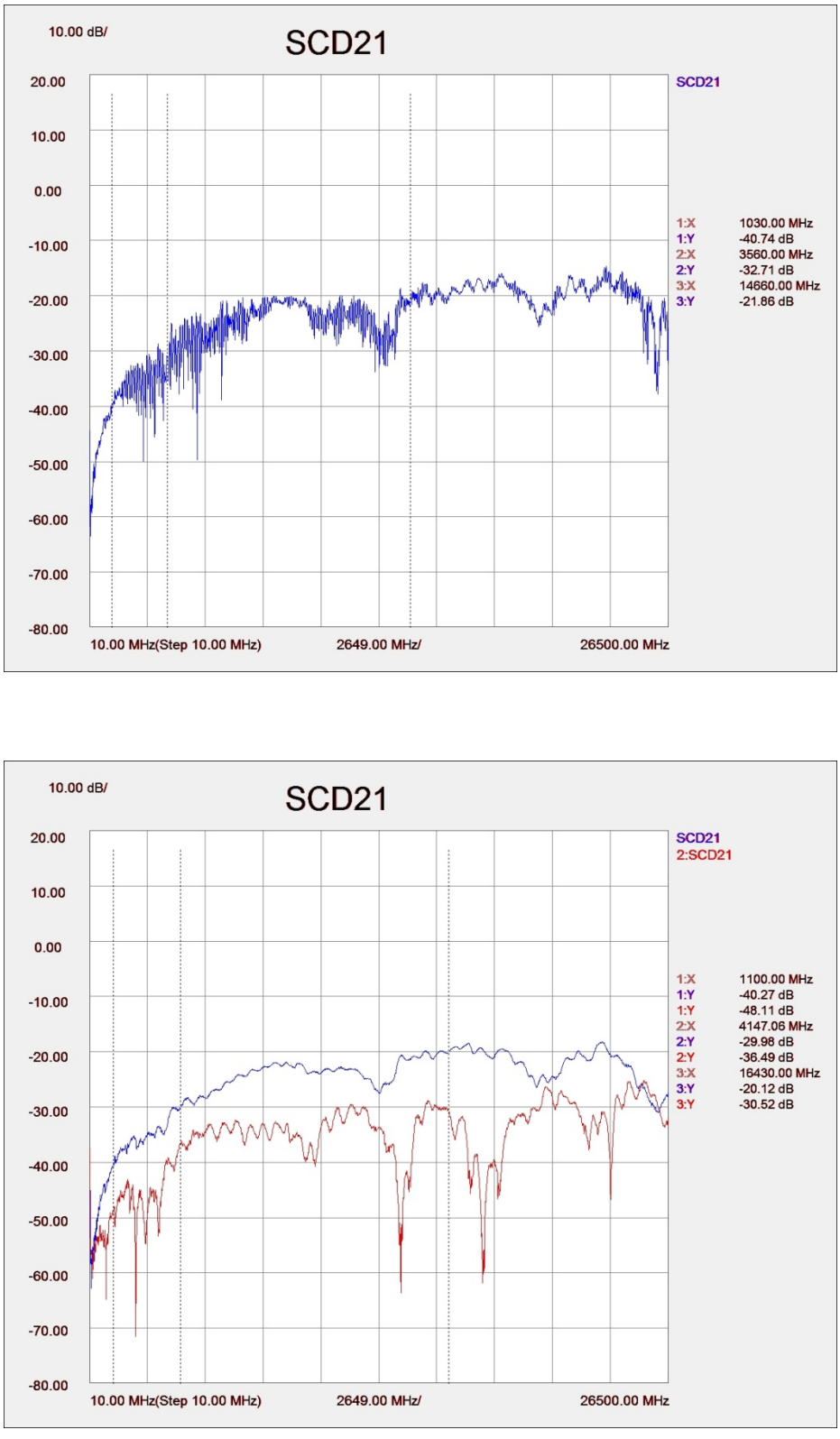

Figure 23. Typical mated pair differential to common mode conversion, with calibration (top) and without calibration (bottom).

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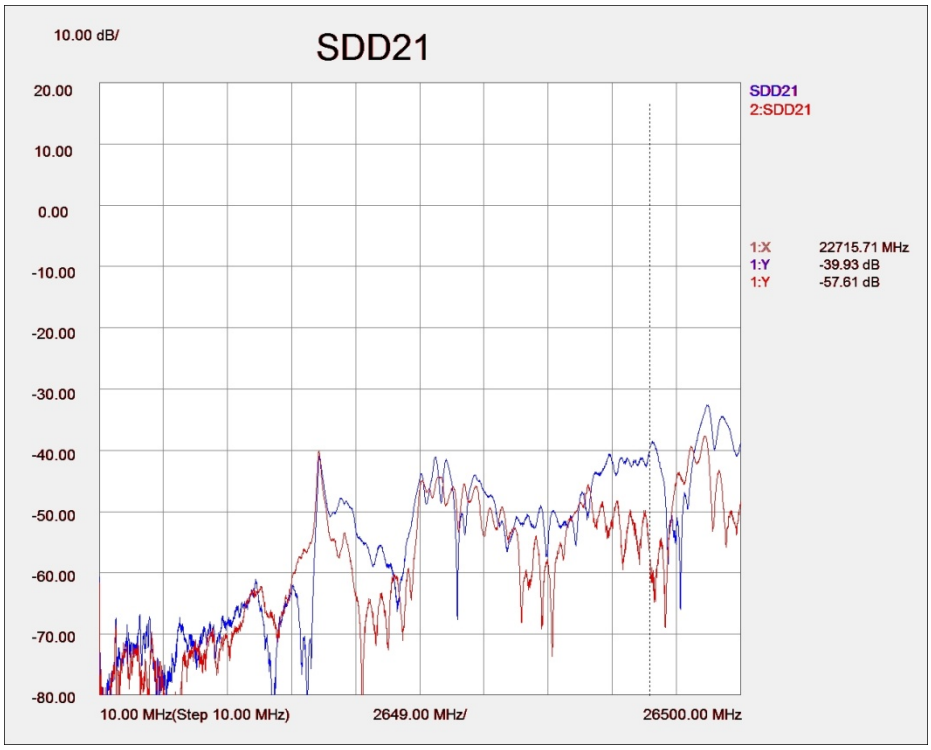

Figure 24. Typical Differential NEXT, with mated connectors, adjacent differential pairs, both transmit and receive terminated at both ends.

Figure 25. Typical Differential FEXT, with mated connectors, adjacent differential pairs, both transmit and receive terminated at both ends.

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Wilder Technologies, LLC – Limited Warranty

Wilder Technologies, LLC warrants that each Test Adapter, 1) is free from defects in materials and workmanship and, 2) conforms to Wilder Technologies specifications for a period of 12 months. **See Consumable and Fragile Material Warranty for exceptions to the 12 month warranty**

The warranty period for a Test Adapter is a specified, fixed period commencing on the date of ship from Wilder Technologies, LLC. If you did not purchase your Test Adapter directly from Wilder Technologies, LLC, the serial number and a valid proof of purchase will be required to establish your purchase date. If you do not have a valid proof of purchase, the warranty period will be measured from the date of ship from Wilder Technologies, LLC.

If, during the warranty period, the Test Adapter is not in good working order, Wilder Technologies, LLC will, at its option, repair or replace it at no additional charge, except as is set forth below. In some cases, the replacement Test Adapter may not be new and may have been previously installed. Regardless of the Test Adapter's production status, Wilder Technologies, LLC appropriate warranty terms apply.

Consumable and Fragile Material Warranty
Wilder Technologies, LLC warrants that consumable materials and all fragile materials supplied by Wilder Technologies, LLC either as part of an instrument or system, or supplied separately, will be free from defects in material and workmanship at the time of shipment.

Extent of Warranty
The warranty does not cover the repair or exchange of a Test Adapter resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which Wilder Technologies, LLC is not responsible. The warranty is voided by removal or alteration of Test Adapter or parts identification labels. The initial three months are unconditional; the remaining months excludes plugs, receptacles and SMA connectors. Connectors are wear items and excluded from the warranty after the initial three months.

These warranties are your exclusive warranties and replace all other warranties or conditions, express or implied, including but not limited to, the implied warranties or conditions or merchantability and fitness for a particular purpose. These warranties give you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction. Some jurisdictions do not allow the exclusion or limitation of express or implied warranties, so the above exclusion or limitation may not apply to you. In that event, such warranties are limited in duration to the warranty period. No warranties apply after that period.

Items Not Covered by Warranty
Wilder Technologies, LLC does not warrant uninterrupted or error–free operation of a Test Adapter.

Any technical or other support provided for a Test Adapter under warranty, such as assistance via telephone with "how–to" questions and those regarding Test Adapter set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND**.

Warranty Service
Warranty service may be obtained from Wilder Technologies, LLC by returning a Wilder Technologies, LLC Returns Material Authorization and the Test Adapter to Wilder Technologies, LLC during the warranty period. To obtain RMA number, contact support@wilder-tech.com.

You may be required to present proof of purchase or other similar proof of warranty entitlement. You are responsible for any associated transportation charges, duties and insurance between you and Wilder Technologies, LLC. In all instances, you must ship Test Adapters in Wilder Technologies, LLC approved packaging. Information on packaging guidelines can be found at: www.wilder-tech.com. Wilder Technologies, LLC will ship repaired or replacement Test Adapter Delivery Duty Prepaid (DDP) and will pay for return shipment. You will receive title to the repaired or replacement Test Adapter and you will be the importer of record.

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Wilder Technologies, LLC – Terms & Conditions of Sale

1. **Other Documents:** This Agreement may NOT be altered, supplemented, or amended by the use of any other document(s) unless otherwise agreed to in a written agreement signed by both you and Wilder Technologies, LLC. If you do not receive an invoice or acknowledgement in the mail, via e-mail, or with your Product, information about your purchase may be obtained at support@wilder-tech.com or by contacting your sales representative.

2. **Payment Terms, Orders, Quotes, Interest:** Terms of payment are within Wilder Technologies, LLC's sole discretion, and unless otherwise agreed to by Wilder Technologies, LLC, payment must be received by Wilder Technologies, LLC prior to Wilder Technologies, LLC's acceptance of an order. Payment for the products will be made by credit card, wire transfer, or some other prearranged payment method unless credit terms have been agreed to by Wilder Technologies, LLC. Invoices are due and payable within the time period noted on your invoice, measured from the date of the invoice. Wilder Technologies, LLC may invoice parts of an order separately. Your order is subject to cancellation by Wilder Technologies, LLC, in Wilder Technologies, LLC's sole discretion. Unless you and Wilder Technologies, LLC have agreed to a different discount, Wilder Technologies, LLC's standard pricing policy for Wilder Technologies, LLC-branded systems, which includes hardware, software and services in one discounted price, allocates the discount off list price applicable to the service portion of the system to be equal to the overall calculated percentage discount off list price on the entire system. Wilder Technologies, LLC is not responsible for pricing, typographical, or other errors in any offer by Wilder Technologies, LLC and reserves the right to cancel any orders resulting from such errors.

3. **Shipping Charges; Taxes; Title; Risk of Loss:** Shipping, handling, duties and tariffs are additional unless otherwise expressly indicated at the time of sale. Title to products passes from Wilder Technologies, LLC to Customer on shipment from Wilder Technologies, LLC's facility. Loss or damage that occurs during shipping by a carrier selected by Wilder Technologies, LLC is Wilder Technologies, LLC's responsibility. Loss or damage that occurs during shipping by a carrier selected by you is your responsibility. You must notify Wilder Technologies, LLC within 7 days of the date of your invoice or acknowledgement if you believe any part of your purchase is missing, wrong or damaged. Unless you provide Wilder Technologies, LLC with a valid and correct tax exemption certificate applicable to your purchase of Product and the Product ship-to location, you are responsible for sales and other taxes associated with the order. **Shipping dates are estimates only**.

4. **WARRANTY:** WILDER TECHNOLOGIES, LLC, warrants that the item(s) manufactured under the Buyer's contract shall be free from defects in materials and workmanship furnished by WILDER TECHNOLOGIES, LLC, and shall conform to the applicable drawings and specifications. WILDER TECHNOLOGIES, LLC'S liability herein, for breach of warranty, contract or negligence in manufacturing, shall be limited to repair or replacement. Repair or replacement of defective items will be applicable only if the Buyer notifies WILDER TECHNOLOGIES, LLC, by written notice within 30-days of delivery. All claims shall be addressed to: support@wilder-tech.com or WILDER TECHNOLOGIES, LLC, 6101A East 18th Street, Vancouver, Washington 98661 U.S.A.; ATTENTION: Customer Service Manager. WILDER TECHNOLOGIES, LLC, reserves the right to inspect at the Buyer's plant all items claimed to be defective or nonconforming prior to authorizing their return. WILDER TECHNOLOGIES, LLC, assumes no liability for the results of the use of its components in conjunction with other electric, electronic or mechanical components, circuits and/or systems. The foregoing constitutes the sole and exclusive remedy of the Buyer and the exclusive liability of WILDER TECHNOLOGIES, LLC, and is IN LIEU OF ANY AND ALL OTHER WARRANTIES, STATUTORY, IMPLIED OR EXPRESSED AS TO MERCHANTABILITY, FITNESS FOR THE PURPOSE SOLD, DESCRIPTION, QUALITY, and PRODUCTIVENESS OR ANY OTHER MATTER. Without limiting the foregoing, in no event shall WILDER TECHNOLOGIES, LLC, be liable for loss of use, profit or other collateral, or for special and/or consequential damages.

5. **RETURNED GOODS:** WILDER TECHNOLOGIES, LLC, will accept only those goods for return that have been authorized for return. All goods authorized for return shall be assigned a Returned Material Authorization (RMA) Number. The RMA Number shall be clearly marked on the shipping container(s) and all documentation accompanying the goods authorized for return. The RMA Number shall be assigned by WILDER TECHNOLOGIES, LLC pursuant to the conditions set forth in Paragraph 4, WARRANTY.

6. **UNITED STATES GOVERNMENT CONTRACTS:** In the event this offer is accepted under Government contract, WILDER TECHNOLOGIES, LLC, agrees to accept clauses required by Government regulations and to waive WILDER TECHNOLOGIES, LLC conditions inconsistent therewith. WILDER TECHNOLOGIES, LLC, certifies that it is a regular manufacturer or dealer of the goods and/or services offered herein and that the prices offered do not exceed those charged to any customer for like quantities, services or materials under the same conditions.

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Compliance with Environmental Legislation

Wilder Technologies, LLC, is dedicated to complying with the requirements of all applicable environmental legislation and regulations, including appropriate recycling and/or disposal of our products.

WEEE Compliance Statement

The European Union adopted Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE), with requirements that went into effect August 13, 2005. WEEE is intended to reduce the disposal of waste from electrical and electronic equipment by establishing guidelines for prevention, reuse, recycling and recovery.

Wilder Technologies has practices and processes in place to conform to the requirements in this important Directive.

In support of our environmental goals, effective January 1st, 2009 Wilder Technologies, LLC has partnered with EG Metals Inc. – Metal and Electronics Recycling of Hillsboro, Oregon, www.egmetalrecycling.com, to recycle our obsolete and electronic waste in accordance with the European Union Directive 2002/96/EC on waste electrical and electronic equipment ("WEEE Directive").

As a service to our customers, Wilder Technologies is also available for managing the proper recycling and/or disposal of all Wilder Technologies products that have reached the end of their useful life. For further information and return instructions, contact support@wilder-tech.com.

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Glossary of Terms

TERMINOLOGY	DEFINITION
Aggressor	A signal imposed on a system (i.e., cable assembly) to measure response on other signal carriers.
Decibel (dB)	Ten times the common logarithm (i.e. log10) of the ratio of relative powers.
Far-end crosstalk or FEXT	Crosstalk that is propagated in a disturbed channel in the same direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
FC16 TPA	FC16 Test Point Access. A specialized assembly that interfaces to a FC16 host or module and enables access of signals for measurement or stimulation.
Host	The Host is the fixed end of the connection supporting 8GFC and 16GFC serial protocols.
Informative	The designation of a test that is not required for compliance.
Insertion loss	The ratio, expressed in dB, of incident power to delivered power.
Module	The Module is the moveable end of the connection supporting 8GFC and 16GFC serial protocols.
Near-end crosstalk or NEXT	Crosstalk that is propagated in a disturbed channel in the opposite direction as the propagation of a signal in the aggressor channel. The terminals of the aggressor channel and the victim channel are usually close to each other.
Normative	The designation of a test that is required for compliance.
Return Loss	The ratio, expressed in dB, of incident power to reflected power.
SFP+	Enhanced Small Form Factor Pluggable connection
Victim	A signal carrier on a system that has a response imposed on it by other signals in the system.

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